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THE ROLE OF PERSONALITY IN DETERMINING VARIABILITY IN EVALUATING EXPERTISE

by

Chris Buziak

September 2000

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This research investigated how different experts in a single domain chose their individual subjective evaluation criteria of a highly aggregate task based upon their individual differences. The Conning Officer Virtual Environment (COVE) was utilized to provide a domain of experts and a subjectively evaluated task. 116 expert ship-handlers were investigated to understand how their personality affects their evaluation of a novice performing an underway replenishment (UNREP). The experts were issued a survey that inventoried their personality, UNREP evaluation criteria, and ship handling style. In general, the participant experts were lower in Neuroticism and higher in Extraversion and Conscientiousness than the average adult. Extraversion appeared to be correlated with the expert's desire to use sensory input as a critical evaluation criterion ($\rho = .18$) while Openness was correlated with analytical input ($\rho = .16$) and UNREP style ($\rho = .16$) as critical evaluation factors. Also correlated with UNREP style was Agreeableness ($\rho = .16$). Finally, the expert's level of Conscientiousness correlated with the critical evaluation criteria of analytical input ($\rho = .17$) and sensory input ($\rho = .39$). Results from this research provide insight to the link

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THE ROLE OF PERSONALITY IN DETERMINING VARIABILITY IN EVALUATING EXPERTISE

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Lieutenant, United States Navy
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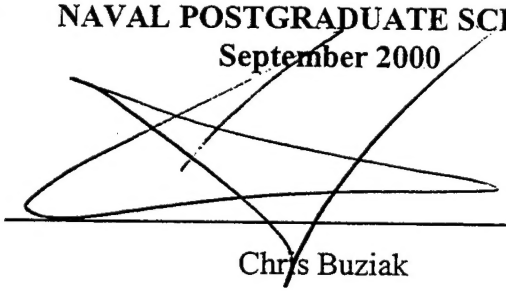
Author: 

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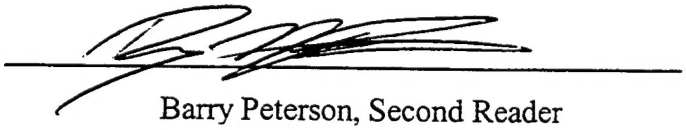

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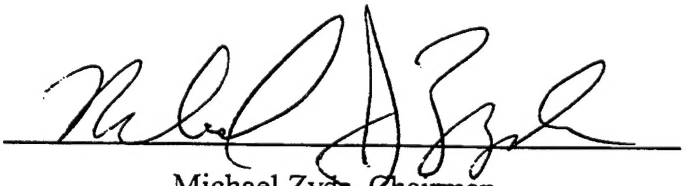

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ABSTRACT

This research investigated how different experts in a single domain chose their individual subjective evaluation criteria of a highly aggregate task based upon their individual differences. The Conning Officer Virtual Environment (COVE) was utilized to provide a domain of experts and a subjectively evaluated task. 116 expert ship-handlers were investigated to understand how their personality affects their evaluation of a novice performing an underway replenishment (UNREP). The experts were issued a survey that inventoried their personality, UNREP evaluation criteria, and ship handling style. In general, the participant experts were lower in Neuroticism and higher in Extraversion and Conscientiousness than the average adult. Extraversion appeared to be correlated with the expert's desire to use Sensory Input as a critical evaluation criterion ($\rho = .18$) while Openness was correlated with Analytical Input ($\rho = .16$) and UNREP style ($\rho = .16$) as critical evaluation factors. Also correlated with UNREP style was Agreeableness ($\rho = .16$). Finally, the expert's level of Conscientiousness correlated with the critical evaluation criteria of Analytical Input ($\rho = .17$) and Sensory Input ($\rho = .39$). Results from this research provide insight to the link between observed behavior and its subjective evaluation and will allow COVE's programmers to develop an Intelligent Tutoring System (ITS) that will customize the automated training process.

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I. INTRODUCTION

A. MOTIVATION

The military services have historically been an apprenticeship system. Beginning with the early days of sail, United States Naval Midshipmen would spend several years serving aboard a single ship with a single captain. Under the tutelage and guidance of his master captain, the apprentice midshipman would learn the art of sail and war. A midshipman would be promoted to the rank of an officer of the line only after gaining his captain's full trust and confidence in his knowledge and abilities. This type of highly specialized training required vast resources and the dedication of numerous personnel.

Whether a sailor, marine, soldier, or airman, the United States Military warrior of the new millennium is required to do more with less. Fewer troops, weapons, training time, and fiscal resources are requiring the armed forces to re-evaluate every facet of operations. In particular, budget draw downs and the increasing complexity of hardware necessitates the need to create cost-effective training alternatives. As computing power and speed increase, the desire for utilizing computers as a beneficial training tool also increases. Using modern computers' ever increasing high fidelity virtual environments (VEs) as a training tool for performing spatial and cognitive tasks are a particular area of increasing demand since VEs provide the potential capability for a trainee to practice and master complex and highly dangerous tasks safely, efficiently, and economically [CAIR96].

B. OBJECTIVE

"The best known generalization in human learning is that practice makes perfect" [ANNE89]. The caveat to this cliché is that the student is practicing the right task in the right ways. The ability to properly react to any situation requires expert guidance and proper intervention at critical points during training. Without a good teacher, practice alone is not always enough to become competent at a complex task. Even more devastating is the possibility that the student will get worse at the learned task and experience a negative training transfer [BOLD87].

While VE is a relatively new training tool, a VE training system is not pragmatically different from any previous generation of training tool. VE training must, just like any other training system, provide students with the skills and knowledge required to meet the demands of the trained task and the needs of the overriding organization [CAIR96]. While any form of training requires several key components to be effective, one of the most essential steps to developing a successful training program is providing quality feedback via instruction and evaluation.

The Conning Officer Virtual Environment (COVE) Ship Handling Trainer is one example of a VE that provides an economically attractive alternative to traditional methods of practicing ship handling while providing an integrated means of instruction. COVE, currently under development by Naval Air Warfare Training Systems Division (NAWC-TSD), simulates ship-handling scenarios where the trainee is immersed in a VE, complete with an integrated intelligent tutoring system (ITS), in the form of a simulated interactive commanding officer. COVE is a flexible and portable unit that is intended to build and reinforce ship-handling skills with minimal requirements for instructor

intensiveness and costly ship resources [MEAD99]. If the deployed implementation of COVE is successful, Junior Officers (JOs) will have an opportunity to develop basic skills and practice difficult scenarios in a controlled environment without the need to have entire ships at sea, saving time, dollars, and possibly even lives.

"Providing the trainee with knowledge of the results is one of the most common training program interventions and one which is generally believed to have a powerful effect on learning" [ANNE89]. In the case of COVE, quality feedback to the trainee requires the ITS to be more than a scripted set of rules. The ITS must provide immediate guidance and feedback that is accurate and meets accepted standards, just as a Commanding Officer (CO) would at sea, else risk the loss of valuable training time and a possible negative transfer training experience [TENN99].

ITS feedback should both conform to accepted, safe practices and the requirements of the JO's CO. However, the dynamics of handling a ship at sea combined with individual differences of COs makes it difficult to have a single standardized set of feedback responses. Just as the original shipmasters trained their apprentices uniquely, today's COs train their JOs according to their predilections. Different COs will have different benchmarks based upon their own style of expertise, experiences, and personality, resulting in different COs evaluating the same evolution differently [NPS99]. In order to gain maximum benefit for the fleet, COVE's ITS must be flexible enough to meet the needs of the different fleet experts.

While a prime example, COVE is just a single example of a trainer that requires extensive knowledge and that has infinitely many ways to arrive at a "correct" solution that is "correct" only in the eyes of the evaluator. Topics easily range from driving ships,

to land navigation, to philosophy. Essentially, anything that involves asynchronous student-paced instruction and training of a highly complex aggregate task that involves subjectivity in evaluation can benefit from the relationships explored by the COVE ITS and student.

This study investigates how simulator performance evaluation should be modeled based upon the personality composition of the evaluating expert. With respect to the COVE trainer, it is desired to understand the different evaluation criteria used by different COs and its relationship to their personality, ultimately resulting in a more accurate ITS where the Virtual CO (VCO) could approximate a wide range of real world COs.

> To be true to form, one would have to have the many different styles of COs within the system and the ability to choose which one you need. At the one end would be the screamer that we may be most familiar with who will throw you off the bridge if you go too far, and at the other end would be the true mentor who lets you get to the point of no return only to help you avoid the collision that you thought was inevitable.
>
> Commanding Officer of an LPD

This accurate modeling results in more effective trainer time by teaching the JO the same lessons his real world CO would teach, increasing the effectiveness and overall benefit of the trainer.

C. THESIS QUESTIONS

The following questions are addressed in this thesis:

- Is there a relationship between one's personality and one's expertise?
- If such a relationship exists, can it be quantified?
- Does it extend beyond individual expertise to the expert's evaluation of others' performance?
- What is the range of characteristics of different ship driving styles?

Addressing these questions is the first step in building a more accurate ITS for COVE. Since this research is only the initial exploration between human behavior and expert evaluation, it is intended to begin the initial compilation of a database for the COVE ITS. Understanding the answers to the aforementioned questions will provide COVE's ITS programmers with a realistic model to base various prototypical VCOs upon. Furthermore, these answers also lay the foundation for automating the relationship and increasing the fidelity between instructor and student in any VE with an ITS. This added insight will help mate the ITS with the student, potentially increasing positive training transfer for any VE training system.

D. APPROACH

In order to answer the questions posed by this research, knowledge about the relationship between experts and novices is required. Along with the nature of expertise,

knowledge about personality and its measurement must be obtained. Furthermore, the scope of this work requires an understanding of the sociological domain within which the experts and novices reside.

Naval officers achieve the prestige of command only by displaying sustained superior performance, primarily at sea. As the senior ship driver aboard, and the one person ultimately responsible for any mishap, the Commanding Officer (CO) is the resident ship-handling expert. How a ship is driven by any of the ship's officers is a direct statement about the ship handling abilities of its CO.

Few evolutions make or break a CO's reputation like the UNREP approach to the auxiliary replenishment ship since the approach is a calling card for the CO's style and ability. While all UNREP experts achieve the same ultimate end goal of coming along side the replenishment ship, different COs accomplish this task differently. Some prefer to "John Wayne" with large speed differentials and small distances from "rubbing paint" while others prefer more of a slow and steady approach. Some COs base decisions on aggregate big picture data while others require more specific input.

While the UNREP is one of the greatest showcases of skills for the surface warfare officer, it is also one of the most dangerous where the potential for loss of life and damage to not only one but also two ships is extremely high. The ability to actually practice this formidable task at sea is limited and can quickly evolve into a situation too complex for a junior officer to handle. These criteria result in good VE training being crucial and indicate that UNREP is an excellent VE candidate since it allows the opportunity for officers to develop prerequisite skills in a safe and controlled environment with minimal operating cost.

Because of all of the aforementioned factors, UNREP was the vehicle for this research and analysis. Its importance in the sociological domain of the ship driver also makes it suitable to determine the correlations with ship driver personality. An analysis of the expert evaluation of an UNREP approach as performed by a less-experienced JO was correlated with the personality of the expert to answer the thesis questions. Results can be directly applied to COVE's existing ITS during COVE simulated UNREPs.

E. SUMMARY OF CHAPTERS

The remainder of this thesis is broken down into the following chapters:

- Chapter II provides background information on the mental and behavioral processes invoked during UNREP and other complex tasks. First, a review of the basic components of an UNREP is performed followed by a summary of COVE and ITS previous research. Next, a more in-depth view of the differences between experts and novices is explored in order to understand the differences between COs and JOs. Additionally, individual differences and their effects on decision making are explored. Finally, personality and its measurement are discussed in order to understand how individual expert COs are different from each other.

- Chapter III discusses the apparatus utilized to gather information for this research. Reasons for selection, design, and development are covered for the two data collection tools, the NEO-FFI personality inventory and the Ship Handler Evaluation Survey.

- Chapter IV delineates the methods utilized for data collection and analysis. An explanation detailing the administration of the survey is provided in addition to a summary of the construction of the data package.

- Chapter V summarizes the results from the data collection and analysis. Results are provided detailing the personality characteristics of the participant expert ship handlers, the critical evaluation criteria utilized by expert ship-handlers for evaluation of novice JOs, and significant correlations observed between personality and critical evaluation criteria.

- Chapter VI presents a final discussion of the results of this thesis and describes areas requiring further research. Answers to thesis questions proposed by this research are addressed in addition to the possible ramifications of this research.

II. BACKGROUND

A. THE UNREP EVOLUTION

The UNREP evolution, while complex and dangerous during execution, is a particularly straightforward task. Two ships, an approach vessel and a replenishment vessel execute the evolution. The approach vessel is a warship that requires replenishment of its fuel and or stores. The replenishment vessel is usually a refueling tanker. The overall goal of the evolution is for the approaching vessel to come within close proximity of the replenishing vessel and bring on fuel and other supplies with out any damage to personnel or equipment.

The UNREP is composed of distinct phases consisting of preparations, waiting, approach, alongside, and breakaway. Figure 1 is a diagram depicting the different phases involved in a plausible UNREP scenario and highlights some of the distances involved between the two ships participating in an UNREP. The evolution actually starts hours before the actual transfer of supplies is executed by performing the preparation phase. Checks of ships systems and a pre-execution brief are performed on both ships to ensure that both the ships and crews are prepared to perform the actual task.

The next phase, the waiting phase, is just prior to the commencement of the approach. During this phase, the approach vessel maneuvers to a waiting station where the approach vessel will perform its last checks and wait for a signal from the

replenishing vessel to commence the approach. The waiting station is usually an area approximately 1000 yards astern of the replenishment vessel.

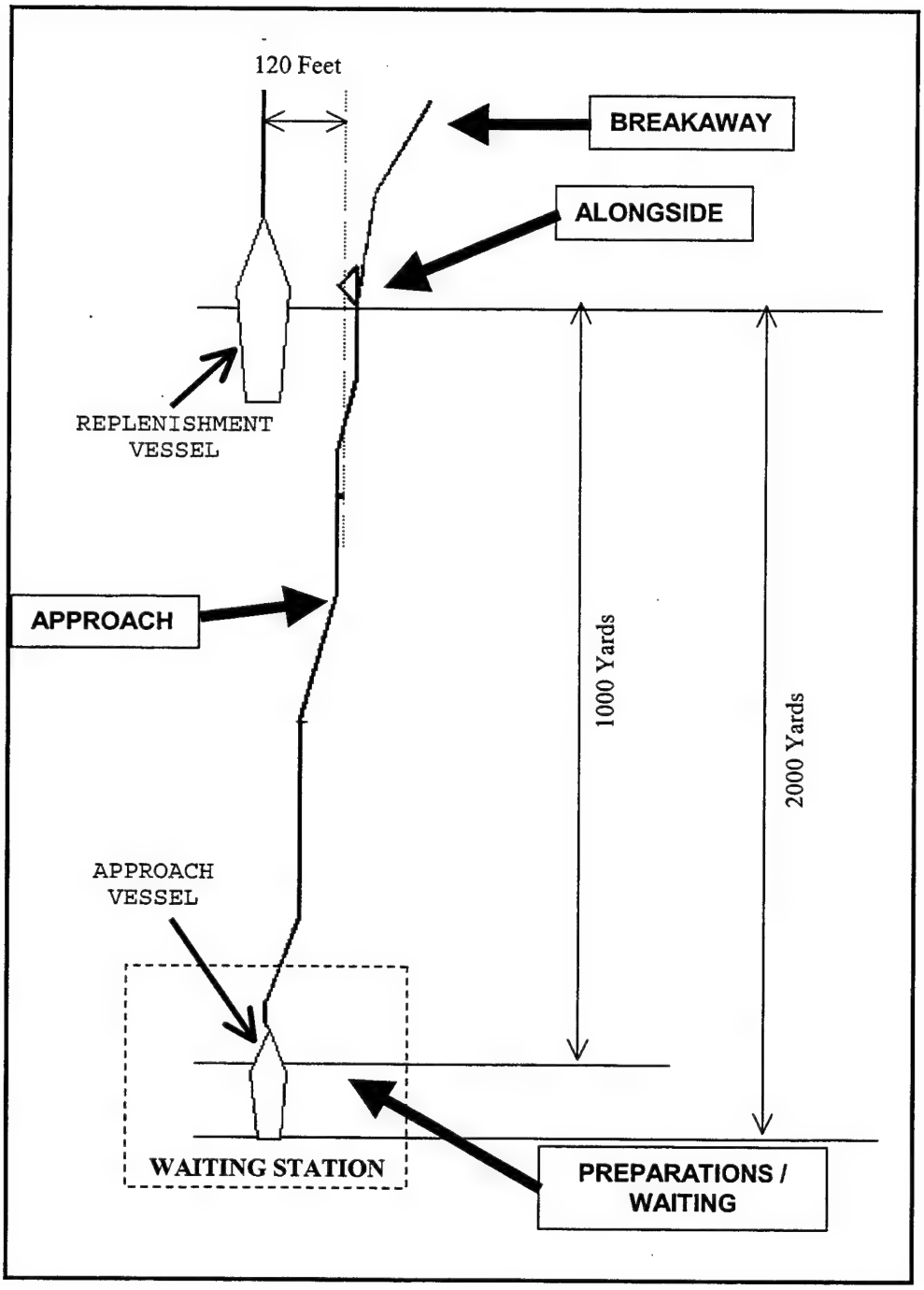

Figure 1: A Diagram of a possible UNREP evolution.

Once both ships are on an agreed upon course and speed and are ready, signals are made and the approach phase commences. During the approach phase, the approaching vessel maneuvers from waiting station to a position directly alongside the replenishment vessel. It is during the approach phase that the first interaction of physical forces occurs between the two vessels.

Once the approach is made, lines connecting the two ships are secured and the approach phase transitions into the alongside phase. During the alongside phase, the approach vessel maintains a constant position relative to the replenishment vessel during the transfer of fuel and stores. Radio communication is maintained between both vessels during the alongside phase until transfer is complete between the replenishment vessel and the approach vessel. Transfer time primarily depends upon the amount of supplies to be transferred, but typically is less than an hour.

Once all supplies are transferred, all connecting lines between the two ships are cast off, marking the beginning of the breakaway phase. During this final phase, the approach vessel maneuvers away from the replenishment vessel. Once clear of the replenishment vessel, the approach vessel is no longer restricted in its ability to maneuver and can proceed on its own independent course and speed.

B. THE CONNING OFFICER VIRTUAL ENVIRONMENT AND INTELLIGENT TUTORING SYSTEM

The COVE trainer is a direct evolvement of a previous project by NAWC-TSD, the Virtual Environment Submarine (VESUB) Simulator. VESUB was intended to

provide a means for submarine officers to practice surfaced submarine evolutions, in particular transit in and out of port, with out the need of a surfaced submarine. COVE combines some of the original VESUB visual simulation architecture with voice recognition and an integrated intelligent tutoring system. Ideally, COVE is a portable, low cost training solution that provides the user with a high fidelity synthetic ship driving experience and requires no operator monitoring or intervention [MEAD99].

Most previously implemented expert systems possess limited capability for diagnosis and feedback making them relatively unsuitable for training purposes [TENN99]. In order for an artificially intelligent (AI) training system to be successful, it must possess the capability to learn from experience by making human-like associations requiring a sense of appropriate output and understanding of needs, desires, and emotions [DREY96]. A possible architecture that meets these criteria incorporates adaptive technology into a pedagogical agent. An example of a first generation ITS is STEVE (Soar Training for Virtual Environments), which is currently under development by the Air Force Research Laboratory [TENN99]. STEVE is designed to be a modular agent implementation for the purpose of instruction in a variety of computer-based learning environments [JOHN98].

The COVE trainer incorporates an ITS in the form of a Virtual Commanding Officer (VCO). The VCO is a pedagogical agent that instructs the JO on how to properly drive the ship during a ship handling evolution such as UNREP [TENN99]. Previous research investigated three possible profiles for the VCO consisting of a passive VCO, a proactive VCO, and an aggressive VCO. The classification of passive, proactive, or aggressive was based primarily on a CO's predilection to recommend course and speed

changes while a JO was conning the ship during an UNREP evolution. The three classifications were chosen for their broad coverage of different ship driving styles and were intended to represent the majority of ship drivers in the fleet.

C. DIFFERENCES BETWEEN EXPERTS AND NOVICES

"... I want the JO to learn to drive the ship the way I drive the ship."

Member of SURFLANT staff addressing
NAWC-TSD about COVE and ITS.

While a CO will usually find other styles acceptable, he will prefer his JOs to drive the ship in a manner similar to his. Much like a father teaching his teenager how to drive a car, the expert CO will first instruct, and later expect the novice JO to analyze data and make decisions in the same fashion as the CO. These expectations are the basis for the expert CO's evaluation of the novice JO and are shaped by the CO's expertise.

UNREPs are dynamic, complex tasks and UNREP skill cannot be neatly categorized under a single type of expertise. Expertise itself is diverse and is segregated into the four following categories: [CHI88]

- PRACTICAL EXPERTISE that primarily deals with motor skills or mental skills. Examples of practical skills are typing, memorizing restaurant orders, or mental calculation. This type of expertise often allows for parallel thought processing.

- PROBLEM SOLVING EXPERTISE requiring specific domain related knowledge. Examples of problem solving expertise are computer programming or solving physics problems.

- ILL-DEFINED EXPERTISE that requires decisions under uncertainty, such as when some uncontrolled intervening event occurs between the choice and the outcome. An example of an ill-defined problem is predicting stock market performance [CHI88].

- DIAGNOSTIC EXPERTISE where metacognition is required to accurately access the reason for a given circumstance or set of facts. An example of diagnostic expertise is properly accessing an illness or medical condition from x-rays or symptoms.

All four of the previous expertise categories apply to an UNREP evolution. Commands are issued and executed with practical expertise. Estimating times and speeds in open-ocean utilize problem-solving techniques. Given the dynamic nature of an UNREP due to the uncontrollable forces of nature and the interactions of two separate independent ship drivers simultaneously, UNREPs require both ill-defined and diagnostic expertise. A novice JO must demonstrate proficiency of all types of expertise in order to receive a favorable evaluation of the UNREP evolution from his CO.

Expert ship handlers usually distinguish themselves from novices by determining the quickest, most efficient courses of action, and when a ship handling evolution is getting out of control. In distinguishing themselves from novices, experts, regardless of the area of expertise, share common traits. These commonalties are summarized as:

- Experts excel mainly at their own domains.
- Experts perceive large meaningful patterns in their domains.
- Experts quickly solve problems with little error.
- Experts have superior short-term and long-term memory.
- Experts see and represent a problem at a deep (more principled) level.

- Experts spend a great deal of time analyzing a problem qualitatively.
- Experts have strong self-monitoring skills.

These traits usually result in an expert performing a task quicker and with fewer errors [CHI88].

Even though experts distinguish themselves apart from novices in common ways, there are still wide variabilities amongst the experts themselves. These variabilities are unique to each expert and are often referred to as individual differences. These differences influence how the expert responds to situations, teaches his novices, and evaluates his trainees' proficiency. Understanding individual differences of the CO are critical inputs to producing useful feedback for the JO.

D. DECISION-MAKING AND INDIVIDUAL DIFFERENCES

A study performed by the U.S. Army Research Institute for the Behavioral and Social Sciences assessing how senior Army officers made critical battlefield decisions discovered that not all experts analyze situations and make decisions the same way [COHE96]. Most experts generally fall into two completely different paradigms. Some experts follow an analytical approach where decision-making is characterized by attempting to use rational and computational methods. In contrast, a recognition expert would attempt to make decisions based on fitting the situation into a known pattern and responding with a familiar label or plan of action.

Another U.S. Army Research Institute for the Behavioral and Social Sciences study investigated the effects of expertise, cognitive style, and mission on what information is used by senior Army officers during tactical decision making in an attempt to develop a tactical decision aid [MICH88]. Their research indicated that a tactical decision aid must be adaptable to individual differences such as personality, cognitive style, and preferences for sensory modality and communication mode. These findings correlate with the research on how Army officers performed under stressful situations. Their findings showed that personality exhibited some consistent patterns of response to stressful situations. Their research assumed that there is a reciprocal causality between individual, situational, and response variables and that the way an individual responds to a situation is directly affected by the individual's personality.

E. THE FIVE FACTOR MODEL OF PERSONALITY AND FEEDBACK

The UNREP is an extremely stressful evolution for both novice and expert. Since an expert CO will perform an UNREP based upon his expertise paradigm, which is shaped by his individual characteristics, it is necessary to study the COs personality. Personality is often explained by the Five-Factor Model (FFM), which describes personality in terms of five distinct personality traits. The " FFM originated in initial works by Fiske (1949), Norman (1963), and Tuppes and Christal (1963), who produced a highly stable structure with five factors" [SALG97]. The FFM is extremely attractive due to its empirical roots. While most models are derived from theoretical perspectives, the lexical FFM has a theoretically neutral position [WIDI97].

The Revised NEO Personality Inventory (NEO PI-R) is modeled after the FFM. It is a widely accepted measure of personality developed by Dr. Paul Costa and Dr. Robert McCrae, assesses personality in terms of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The five personality factors are described in the following way:

- EXTRAVERSION is the factor that describes people who are rated by their peers as "sociable, fun-loving, affectionate, friendly, and talkative" [MCCR87] versus "reserved, timid, and quiet" [SALG97].

- People high in AGREEABLENESS are forgiving, lenient, sympathetic, agreeable, and softhearted, according to peer ratings [MCCR87]. Peers describe those low in Agreeableness in more negative terms: ruthless, uncooperative, suspicious, and stingy.

- Peers describe people high in CONSCIENTIOUSNESS as careful, well organized, punctual, ambitious, and persevering [MCCR87]. Conscientiousness "includes both proactive (hardworking, ambitious) and inhibitive (dutiful, scrupulous) aspects" [MCCR89].

- People who score high on NEUROTICISM typically report negative emotions such as worry, insecurity, self-consciousness, and tempermentalness [MCCR87] whereas people with low Neuroticism are calm, self-confident, and cool [SALG97].

- The final factor in this model is OPENNESS. Adjectives from lexical studies that describe this factor include "original, imaginative, broad interests, and daring" [MCCR87]. "Openness defines individuals who are creative curious, and cultured versus practical with narrow interests. [SALG97]"

The five factors of personality have implications for occupational performance and therapy. Most research studying the relationship between personality and job performance only attempts to correlate quality of job performance with personality

[CLON96]. Two meta-analytic studies by Barrick and Mount (1991) and Tett and Jackson (1991) find that Conscientiousness is the only predictor of quality of job performance [RUST99].

There is less research on the link between individual differences and method of task completion. A previous study showed correlation between individual differences and variability in expertise [NPS99]. Specifically, ship handler's methods for performing an UNREP varied into two distinct categories, analogical or analytical. Whether a CO performed an UNREP in an analytical fashion, or an analogical fashion could be correlated with the CO's personality and cognitive style. A study investigating the theory that personality is more differentiated at higher levels of ability discovered that some personality traits are statistically more variable for individuals at high versus low levels of ability [AUST97]. This research also showed relationships between types of judgment and FFM factors and Intelligence Quotient (IQ).

Rust, 1999, investigated the ability of the FFM to predict supervisor's ratings of performance. In his research, Rust administered the Orpheus; broad-spectrum work based personality questionnaire to employees. His findings showed a correlation between the FFM results of the self-evaluation Orpheus and appropriate supervisor ratings. In evaluating the FFM within the context of work based behavior:

- High extroversion people are generally happier working with others while low extroverts tend to prefer work requiring independence.
- High agreeableness results in individuals with a desire for a more cooperative, problem-solving approach the lower Agreeableness results in an ability to make tough decisions.

- People displaying high openness to experience seek alternative solutions and desire different methods, while low openness to experience individuals desire traditional approaches and respect established values.

- Low neurotics tend to disregard feelings of others, perform better under stress, but tend to lack caution.

- High conscientious people tend to excel at detailed tasks, but may become over involved in minutiae while low conscientiousness people have little patience for mundane tasks, and prefer to see the big picture.

[RUST99]

This research is important because personality is a factor for how a CO learns, and subsequently trains. The expert is more inclined to use teaching techniques in a manner that he understands the best. Previous research has attempted to correlate personality traits with various learning styles. This research indicated that Extroversion and Agreeableness are linked with more active types of learning [FURN96]. Therefore, it is a conclusion that Extroversion and Agreeableness could explain active forms of teaching. In the case of an UNREP, these personality traits could explain why some COs are more actively involved with the JO during the evolution than others are.

Salgado analyzed three prior meta-analysis studying the relationship between personality and job criteria. In general, Salgado discovered that "Extraversion is a valid predictor of training proficiency ($\rho = .26$), as are Neuroticism ($\rho = .07$), Agreeableness ($\rho = .10$), and Openness to Experience ($\rho = .25$)" [SALG97]. Furthermore, personality compatibility between teacher and student will potentially affect the teacher's evaluation of an evolution. Research demonstrates that students achieved higher levels in classes when teacher-student personality compatibility is high [FURN96]. This teacher and

student dynamic should also apply to VE training, and if properly modeled, will further increase the accuracy of the training feedback.

F. PERSONALITY MEASUREMENT

The assessment of personality is a major application of psychology to real world concerns and is extremely varied in its administration and utilization. Clinical psychologists evaluate a patient's personality in an attempt to determine if the patient possesses abnormal symptoms or feelings. A school psychologist will assess a child's personality in order to determine any causes of possible learning or adjustment problems. Counseling psychologists attempt to determine the best job for a particular person by matching the individual's needs and interests with the requirements of the position. Finally, research psychologists assess the personalities of experiment participants to account for experimental behavior or correlate personality characteristics with other measures [SCHU90].

Regardless of the end goal, some assessment techniques are more objective while some techniques are wholly subjective and prone to bias. The best techniques possess standardization, reliability, and validity. Standardization insures consistency and uniformity of the procedures utilized for the test administration. Reliability insures consistency of results to the assessment device. Finally, validity insures that the test device results are an accurate measurement of the intended measured variables [SCHU90].

Multiple methods exist to assess personality. A primary method is referred to as the self-report inventory method. In the self-report method, people report on themselves by answering questions about their feelings and behavior in a variety of simulated situations. The person taking the test must indicate how closely each item describes their own characteristics or how much they agree with each item. In general, self-report personality assessment methods are high in reliability and validity due to the standardized nature of administration, scoring, and evaluation of the results [SCHU90].

The Myers-Briggs Type Indicator (MBTI) is a self-report personality survey created by Katharine Briggs and Isabel Briggs Myers in the 1920s. The MBTI is based upon Carl Jung's model of personality and is the primary method for measuring Jungian personality types. The MBTI measures introversion and extroversion and is used for research purposes as well as career counseling. The MBTI requires several hours to administer and evaluate and requires a trained psychological professional to interpret the scores.

The Minnesota Multiphasic Personality Inventory (MMPI) is another frequently utilized personality assessment tool. The MMPI determines personality traits of hypochondriasis, depression, hysteria, psychopathic deviate, masculinity-feminity, paranoia, psychasthenia, schizophrenia, hypomania, and social introversion. The MMPI is primarily used by clinical psychologists as a diagnostic tool for assessing personality disorders, but is also utilized as a vocational tool. Unfortunately, like the MBTI, the MMPI is extremely long to administer and requires special training to interpret the results.

Projective testing methods are primarily utilized for assessing disturbed individuals. When presented with an ambiguous stimulus, such as a Rorschach inkblot, the patient will project personal needs, values, and fears onto the stimulus description. Projective techniques suffer from low reliability and validity due to the subjective nature of the result evaluations [SCHU90].

Behavioral assessment procedures evaluate a person's behavior to a specific situation. Researchers assessing the personality of an entire group of people primarily utilize this method. For example, hospital staff will routinely observe patient behavior in order to identify behavioral trends in patients. This method requires specifically trained observers and is highly subject to observer bias, resulting in lower reliability and validity [SCHU90].

III. APPARATUS

A. NEO FFI

The modeling of an expert CO response to an UNREP evolution is theoretically possible if the individual differences of each CO can be ascertained. Collecting accurate data about individual differences of COs requires selecting the correct personality assessment tool. Most COs are limited on time and relatively unsupportive of academic endeavors that take away from their operational duties. While the assessment tool must be highly reliable and valid, because of the population being examined and the purposes of this research, it must also be easy to administer, easy to complete with minimal time requirements, and easy to evaluate with little training required.

While the MMPI is a predominantly used objective test for assessing personality, it is primarily used for assessing personality disorders [BERN94]. The MBTI is a widely utilized personality inventory implemented in career related management, but requires a trained psychological professional to administer and is too time intensive for the purposes of this research [SCHU90]. Though there are a number of objective tests designed to measure a broad range of personality variables in a normal population, an increasingly popular choice is the Neo Personality Inventory (NEO PI-R) [BERN94]. The NEO PI-R is a prime choice for inventorying an expert's personality since it is the predominant measure of the five factor model of personality [WIDI97]. The NEO PI-R consists of 240 statements to which a person indicates an extent of agreement on a 5-point scale. The

NEO PI-R is often referred to as a lexical five factor model since it attempts to define personality in natural language terms.

The "majority of academic psychologists, increasingly favor the NEO PI-R for assessment and research" [FURN96]. Furthermore, substantial research exists regarding NEO PI-R reliability and validity. Most important, the NEO PI-R has demonstrated consistent convergent and discriminant validity, as well as indicating how alternate models can be understood from the perspective of the five factor model [MCCR89]. Multiple studies have correlated established measures with the NEO PI-R to establish overlap, including the Eysenck Personality Inventory and Myers-Briggs Type Indicator [FURN96].

The creators of the NEO PI-R re-evaluated the usefulness and applicability of their personality assessment test. Their findings indicated "far more evidence of its comprehensiveness, universality, and practical relevance today than when the NEO-PI was first published" [MCCR97]. The NEO Five Factor Inventory (NEO-FFI) is a brief 60-question subset of the full 240 question NEO PI-R. The NEO PI-R's additional length allows for more precise measurement and better false answer detection while the NEO-FFI shorter length accommodates a quicker administration time for the participant. Since the creators of the NEO PI-R do not envision any significant changes in the structure of the NEO PI-R in the near future, it is a logical conclusion that there are no major revisions planned for the NEO-FFI.

The NEO-FFI scales show correlations with the NEO PI-R ranging from .75 to .89 for each of the five factors. As subsets of the NEO PI-R domain scales, the NEO-FFI scales carry portions of the demonstrated validity of the full scales. While the NEO-FFI

scales are not equivalent to the full scales of the NEO PI-R, the shorter scales are approximately 85 percent as accurate as the full scales. In the case of the abbreviated scales of the NEO FFI, some precision is traded for speed and convenience [MCCR92].

Previous research inventoried five senior US Navy Surface Warfare Officers for individual differences to determine variability in personality using the NEO-FFI [NPS99]. Participants consisted of five Unites States Navy Commanders, military pay grade of O-5, all of which have been designated Surface Warfare their entire careers. Four of the five had served in Executive Officer positions as their last sea going billet, and one had served as a Commanding Officer. All five participants scored in the low category for Neuroticism with little variance. On average, the participants were high in Agreeableness and Extraversion and average in all other categories. The participants exhibited large variances in Openness and Agreeableness scores.

This previous research justified the choice of the NEO-FFI as the tool to assess the personality of expert ship drivers [NPS99]. All participants clearly understood the standardized directions and had no questions. During the pilot experiment, the inventory was easy to administer and on average took less than 10 minutes to complete. Evaluation of the results required minimal time and were very easy to interpret by the researcher who had no formal personality assessment training.

B. EXPERT SHIP HANDLING SURVEY

As part of developing initial profiles for a VCO for COVE, a ship handling background questionnaire was utilized. While the questionnaire was primarily for

demographic purposes, it did attempt to elicit participant opinions about how to train a junior ship driver. The questionnaire was combined with ship driver interviews in order to determine the basic VCO framework [TENN99].

Previous research surveying and analyzing ship-driving Commanding Officers highlighted traits and characteristics that are the same as the traits exhibited by experts [TENN99]. Based upon this commonality, experienced ship-drivers were identified as experts. Expounding upon the original research, this investigation also utilizes a survey. In the early phases of research development, it was determined that a large population of expert participants was desired to ensure that the full spectrum of ship driving styles was approached. Unfortunately, because of logistical constraints, any form of physical interview was impractical. Therefore, the investigator decided to utilize a survey for the primary method of ship driving style elicitation.

Survey questions were primarily based upon previous research examining individual differences and ship driving style [NPS99]. In the previous research, the participating expert ship handlers were administered an open ended interview regarding UNREP. The expert participants were encouraged to state what the key factors were when they evaluated novice ship handlers. The results of these expert interviews build the fundamental core of this research's survey.

However, utilizing a questionnaire for the ship driving style elicitation posed challenges that required significant consideration. Since the survey was to be performed remotely by the ship handling evaluator participants, the survey must be extremely clear since the researcher would not be present to make any clarifications. The size of the population of expert ship-handlers precluded qualification of a participant as an expert for

reasons other than experience and position. Also, the questionnaire had to be concise since most expert ship handlers have limited time to diverge from their duties of running a warship. The goal was to maintain the expert ship handling survey completion time to under 15 minutes.

The survey format primarily utilizes multiple choice or rating questions to elicit the desired information from the participant. Rating questions were specifically chosen because they produce an actual or absolute value of the trait being measured. This required developing the rating scale with equal intervals with an anchor position. These traits result in rating questions being easier to write and prone to fewer errors [GAO93].

Figure 2 details the ratings utilized for the survey. The rating scale was specifically developed to minimize respondent error and bias. The list of possible choices was set at five since most respondents can only distinguish between five to nine items [GAO93]. Furthermore, the list was maintained short in order to reduce primacy and recency effects, effect where respondents are biased toward the last few items because those are freshest in memory of a long list of items. The list of possible rating responses was always presented in the same ascending order to facilitate proper understanding of each rating and help aid recall.

Another primary concern with developing a question involves avoiding inappropriate questions. The expert ship-handling domain is extremely sensitive to perceived right and wrong ways of doing business. For example, this requires avoiding questions that might require an answer that is directly contrary to guidance or doctrine. Regardless of whether or not the expert disagrees with doctrine, it would be socially

unacceptable for the expert to declare that he conducts business in a contrary manner. In general survey questions were developed to avoid the following questions that:

- Are not relevant to the evaluation goals;
- Are perceived as an effort to obtain biased or one sided results;
- Cannot or will not be answered accurately;
- Are not geared to the respondent's depth and range of information, knowledge, and perceptions;
- Are not perceived by respondents as logical and necessary;
- Require an unreasonable effort to answer;
- Are threatening or embarrassing;
- Are vague or ambiguous; or
- Are unfair

[GAO93].

Not Applicable **(N/A)** -There is no need to perform this action.
Applicable **(A)** - This is a relatively minor action with large room for variation of execution.
Somewhat Important **(SI)** - An action that must be performed to have a successful UNREP approach, but with some room for variation of execution.
Important **(I)** – This action must be performed well to have a successful approach with little variation of execution.
Critical **(C)** - It is impossible to successfully complete an UNREP approach without performing this action flawlessly.

Figure 2: Rating scale utilized for the Ship Driving Style Survey

In addition to avoiding inappropriate questions, the questions themselves "must be direct, orderly, precise, logical, concise, and grammatically correct. They must have unity, coherence, and emphasis" [GAO93].

C. EXPERIMENT PACKAGE

The experiment package consisted of a single survey consisting of five subsections:

- Introduction and Background.
- Participant Expert Ship handler Demographic Questionnaire
- Personality Inventory
- Expert Ship Handler Survey
- Conclusion and Comments.

The overall goal was to maintain the total completion time to less than 30 minutes, because it was a reasonable amount of time to accommodate completion of the survey during a lunch hour or other mealtime underway or in port. Furthermore, anonymity and privacy were highly stressed to promote participation and help elicit higher quality responses.

Two forms of the survey were created, an Internet based survey and a traditional paper based survey. The layout of the traditional paper based survey utilized Government Accounting Office (GAO) survey guidelines for design. For example, font size was maintained at 10-point type and text was arranged into two columns to promote ease of

reading [GAO93]. The survey was printed front to back to minimize the apparent size of the document, reducing the likelihood that a potential expert ship handler would not complete the survey due to time requirements. Furthermore, the survey was bound to improve appearance and better accommodate the participant.

The Internet based survey was created in order to allow participants the opportunity to complete the experiment without having to return any package via the mail system. Content was exactly identical to the paper based version, however some formatting was changed to better accommodate viewing on a 17 inch computer monitor. The visual layout was optimized for an 800x600 pixel screen size. The Internet based survey also automated data collection by sorting the participants' responses into a database, removing the possibility of any data corruption by the researcher. This version of the survey was created using Microsoft FrontPage 2000® web development software with all code generated into Hyper Text Markup Language (HTML).

Prior to commencement of the experiment, two senior surface warfare officers stationed at Naval postgraduate School tested the Internet version of the survey for usability and functionality. One usability participant was a senior Navy Commander, military pay grade O-5, who had previously served in the position of Executive Officer of a warship at sea. The other participant was a senior Navy Captain, military pay grade O-6, who had previously served as a Commodore of a squadron of warships. Changes regarding content of the Internet version of the survey were also made in the paper-based version of the survey to maintain continuity between the two experiment forms.

Every expert ship handler requested to participate in the experiment was mailed the following items:

- Cover letter requesting participation from either Commander Surface Naval Forces Atlantic Vice Admiral Giffin (see APPENDIX A), or Commander Surface Naval Forces Pacific Vice Admiral Moore (see APPENDIX B).

- Addendum to instructions detailing how to complete the Internet based version of the experiment survey (see APPENDIX C).

- A paper based copy of the experiment survey (see APPENDIX D).

- A pre-addressed return envelope.

While every United States Navy surface warship possesses Internet capability while in port or at sea, every expert ship handler was given the choice of participating via either the Internet based or traditional paper based survey version. While possessing the capability, it might not be feasible for an expert ship handler to participate in the experiment electronically because of operational constraints or material maintenance. Furthermore, the dual method of participation accounted for problems with electronic participation and also helped prevent requested experts from not participating because they were not comfortable with the method of electronic participation.

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IV. METHODOLOGIES

A. EXPERT POPULATION CANIDATES

> Along with deciding what to ask, evaluators must decide whom to ask. The people questioned must have the information the evaluators seek, they must be readily identifiable and accessible, they must be willing and able to answer, and they must be representative of the population being measured.
>
> [GAO93]

Since the purpose of this research is to learn about the relationships between expert evaluators and novices performing a subjective task, the experiment obviously required experts in a position to evaluate novices. Because COVE is the vehicle for the research, the target population of this research was the expert ship-handlers in a position to train and evaluate junior novice ship-handlers.

Even though the CO is the ultimate person responsible for all ship operations and sets the tone for the conduct of all operations, he is not necessarily the only instructor and evaluator. In most circumstances, even during an UNREP, the Executive Officer (XO) also plays a vital role in instruction and evaluation of junior novice ship-handlers by augmenting the CO as an additional coach or evaluator. While not as common, a Department Head (DH) is an occasional additional mentor to the junior ship-handler and sometimes provides input to the CO for evaluation of the JO.

The experiment primarily targeted a sample of COs and XOs currently serving aboard warships in the fleet. DH survey participation was also accepted if the DH was a recognized ship-handling expert by his CO or XO. These experts were selected because they are currently performing the analyzed task and are most familiar with the current doctrine and equipment utilized in the fleet. In addition to being a CO, XO, or DH, the expert candidate must be serving on a class of warship that conducts UNREPs as the approach vessel. This resulted in the exclusion of small craft such as mine hunters and coastal patrol craft. Furthermore, while tankers occasionally perform an UNREP as the approach vessel, non-Navy personnel who might not possess the same background as the targeted expert population usually operate them.

Based upon the class of ship criteria, there were a combined total of 171 eligible warships between the Atlantic and Pacific naval forces. Since every US Naval warship has both a CO and an XO, there were a total of 342 potential ship-handling experts to sample from. While a larger sample size of ship-handling experts will be a better approximation of the total population of ship-handling experts, a minimum of 30 experiment participants is required to satisfy the Central Limit Theorem statistical rule of thumb [DEVO95].

B. SURVEY ADMINISTRATION

Experiment packages were assembled and mailed via United States Post Office First Class delivery to all 342 ship-handling expert candidates. The candidates were allowed approximately three weeks until the beginning of July 2000 to complete either

the web based or paper based survey. The administration period was selected to accommodate mail time both to and from the ship as well as an adequate time to review and complete the survey.

If the web-based version was completed, the experiment participant was instructed to not return the paper-based version. If the participant completed the paper-based version, the data was recorded utilizing the web-based survey after verifying that the paper-based survey was not a duplicate of an already submitted web-based survey. This manual conversion of survey format was performed to accommodate automatic data collation and analysis.

C. ANALYSIS

All raw survey results were compiled into a single Microsoft Access® database. The database file was then exported into a Microsoft Excel® spreadsheet. Once in Excel format, the raw personality scores for Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C) were computed.

Questions from the ship-handling evaluation section of the survey were classified as one of six distinct types consisting of:

- INTERACTION questions measuring the expert ship-handler's preference for interaction between the novice JO and other entities. Other entities could consist of the other members of the bridge team, the replenishment ship, or the expert ship-handler himself.
- ANALYTIC INPUT questions measuring the expert ship-handler's preference for the type of rational based decision information that a

junior novice ship-handler should use. Examples of Analytic Input are rules of thumb, numerical data from ship's sensors, and standard operating procedures,

- SENSORY INPUT questions measuring the expert ship-handler's preference for the type of instinctual based decision information that a junior novice ship-handler should use. Examples of Sensory Input are visual approximations for range, non-numerical or non-calculation based rules of thumb, and kinesthetic approximations for weather forces.

- COMMUNICATION questions measuring the expert ship-handler's preference for the type of communications the junior novice ship-handler should use. Examples of Communication are internal and external communications circuits.

- UNREP STYLE questions measuring the general expert ship-handler's approach to UNREP and what he expects of the junior novice ship-handler. UNREP Style questions also include the expert ship-handler's general interpretation of UNREP guidance and doctrine.

The average response for each of the six groups was calculated for each expert ship-handling participant. All data was then converted into an input file for the ARC software package, a menu driven statistical analysis tool developed at the University of Minnesota for applied regression.

Once the data package was loaded into ARC, a statistical summary of the data package was created. The statistical summary contains information such as mean values, minimum and maximum values, median values, and standard deviations. Furthermore, the statistical summary contains a matrix of correlation values between the different variables of the data package. It is from this matrix that significant correlations were retrieved for discussion.

V. RESULTS AND DISCUSSION

A. PARTICIPANT DEMOGRAPHICS

Of the 342 ship-handling experts polled, 136 experts participated in the survey, of which 35 participated via the Internet. Eight surveys were incomplete and not used in the data analysis. One survey was completed by a participant who did not meet the criteria of a ship-handling expert as defined for this experiment. Eleven surveys were returned too late to be included in the data analysis package. The resulting data analysis package consisted of a total of 116 surveys.

At the time of the survey administration, 65 survey participants were serving in the CO billet and 48 were serving in the XO billet, and 2 were serving in the DH billet. Of all participants, only two ship-handling experts are female. Table 1 further summarizes some demographical information of the 116 analyzed ship-handling expert participants.

On average, the ship-handling expert participants had served under eight different COs during their career. Furthermore, the average participant had performed between 50 and 100 UNREPs during their career with a single ship-handling expert who had performed over 300 UNREPs. Eight participants were aviators and have not been surface warfare qualified for their entire careers. Major ship classes represented consisted of:

- Aircraft carriers, including both nuclear powered (CVN) and non-nuclear powered (CV) types,
- Guided missile cruisers (CG),
- Destroyers, including both guided missile (DDG) and non-guided missile (DD) types,
- Guided missile frigates (FFG),
- Transport ships including amphibious assault ships (LHA/LHD), dock landing ships (LSD), tank landing ships (LST), and amphibious transport dock ships (LPD),
- Other warships not classified above.

Figure 3 is a histogram that delineates the frequency of ship types for the participating expert ship-handlers. Figure 4 is a histogram that describes the participant billet distribution between observed ship types.

	Average Observed	Minimum Observed	Maximum Observed	Standard Deviation
Age (Years)	40.4	33	50	4.1
Rank	Commander	Lieutenant Commander	Captain	N/A
Years Of Service As An Officer	18.1	11	28	3.9
Years Of Service At Sea	10.5	5	22	3.1

Table 1. Demographic Information for Ship-Handling Expert Participants.

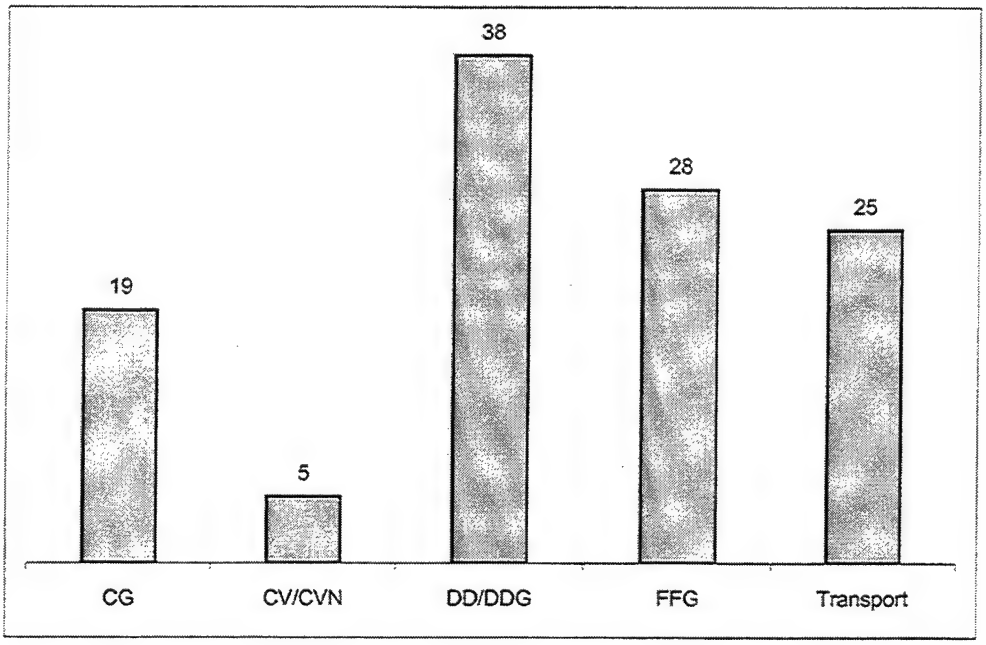

Figure 3. Frequency of Participant Ship-Handling Expert Ship Types

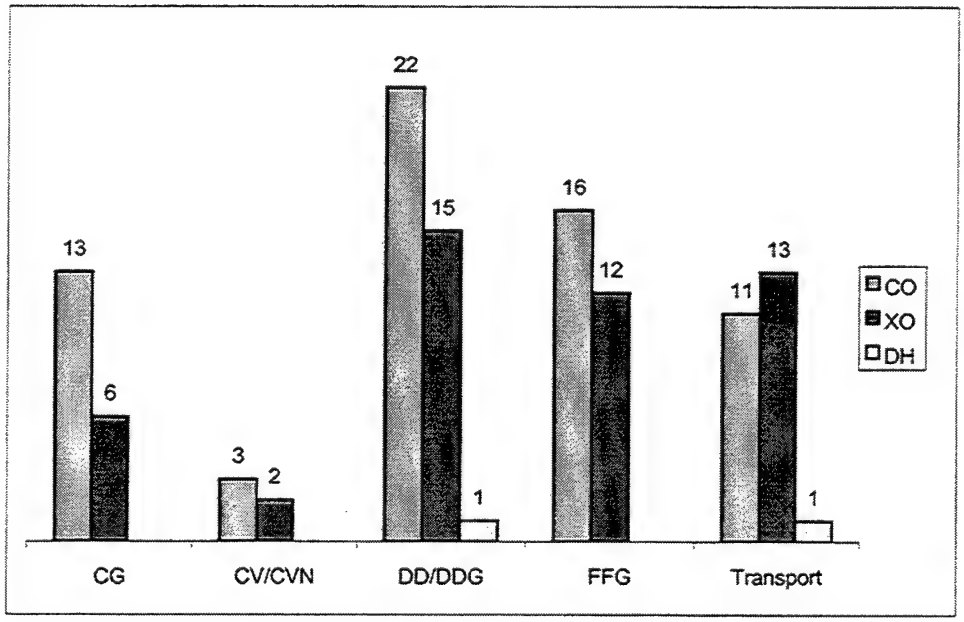

Figure 4. Frequency of Billet Distribution Among Participant Ship-Handling Expert Ship Types

B. PERSONALITY INVENTORY RESULTS

Table 2 provides a statistical summary of the observed expert ship-handler NEO-FFI results. Figure 5 highlights the personality differences between the average participant expert ship-handler and the average over 18 year-old adult participants as defined within the NEO-FFI manual [MCCR92]. Means and standard deviations are contrasted for each personality trait. Notable differences are evident in Neuroticism, Extraversion, and Conscientiousness.

	Neuroticism (N)	Extraversion (E)	Openness (O)	Agreeableness (A)	Conscientiousness (C)
Average	10.91	34.69	27.36	32.67	38.66
Min	0.00	15.00	15.00	13.00	24.00
Max	31.00	46.00	43.00	46.00	48.00
Mode	6.00	33.00	27.00	34.00	36.00
Median	10.50	35.00	27.00	33.00	39.00

Table 2. Statistical Summary For Participant Expert Ship-Handler NEO-FFI Results

Table 3 delineates the personality differences amongst the participant expert ship-handlers. Personality scores were relatively consistent with the exception of carrier expert ship-handlers. On average, carrier ship-handling experts are significantly lower in Neuroticism and higher in Openness and Agreeableness. These personality differences could be related to the demographic difference between carrier ship-handlers and other surface ship-handlers since all carrier COs and XOs are aviators. The only other demographic group to show slight deviations from the whole was the cruiser ship-

handling experts who typically scored slightly lower in Neuroticism and higher in Extraversion than the average participant expert ship-handler.

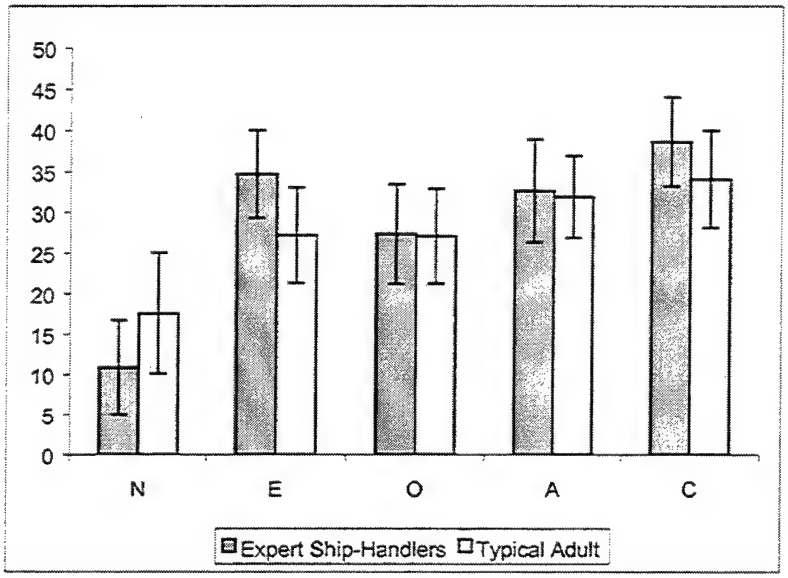

Figure 5. A Comparison of Observed Expert Ship-Handler Means and Standard Deviations to Typical Adults As Defined By The NEO-FFI Professional Manual.

	CG	CV/CVN	DD/DDG	FFG	Transport
Neuroticism	9.53	6.60	10.03	13.96	11.35
Extraversion	37.00	39.20	34.33	33.04	33.69
Openness	26.42	32.40	27.80	26.96	26.39
Agreeableness	29.74	39.00	32.72	32.96	33.19
Conscientiousness	40.11	42.20	38.69	38.11	37.23

Table 3. Mean Participant Expert Ship-Handler NEO-FFI Results For Each Major Participant Ship Class

In order to compare a participant's raw personality score to an average distribution of adults, the raw score is converted into a standardized classification group. The standardized personality classification groups consist of very low, low, average, high, and very high. Ranges for each of the classifications depend upon which score is being classified. Table 4 contains the standardized values for each personality classification range as defined in the NEO-FFI manual [MCCR92].

	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
Very Low	0 - 6	0 – 18	0- 18	0 - 24	0 - 25
Low	7 - 13	19 - 24	19 – 23	25 - 29	25 - 30
Average	16 - 21	25 - 30	24 - 30	30 - 34	31 - 37
High	22 - 29	31 - 36	31 - 36	25 - 40	38 - 43
Very High	30 - 50	37 - 50	37 - 50	41 - 50	44 - 50

Table 4. NEO-FFI Standardized Raw Score Classification Ranges

Figure 6 is a histogram depicting the frequency of Neuroticism scores amongst the participant expert ship-handlers. The distribution is positively skewed indicating that a majority of the participant expert ship-handlers possess low Neuroticism. Figure 7 is a histogram that illustrates the distribution of Neuroticism classifications amongst the participant expert ship-handlers. Figure 7 confirms that 97% of the participants possess average or lower than average Neuroticism as defined in Table 4 [MCCR92].

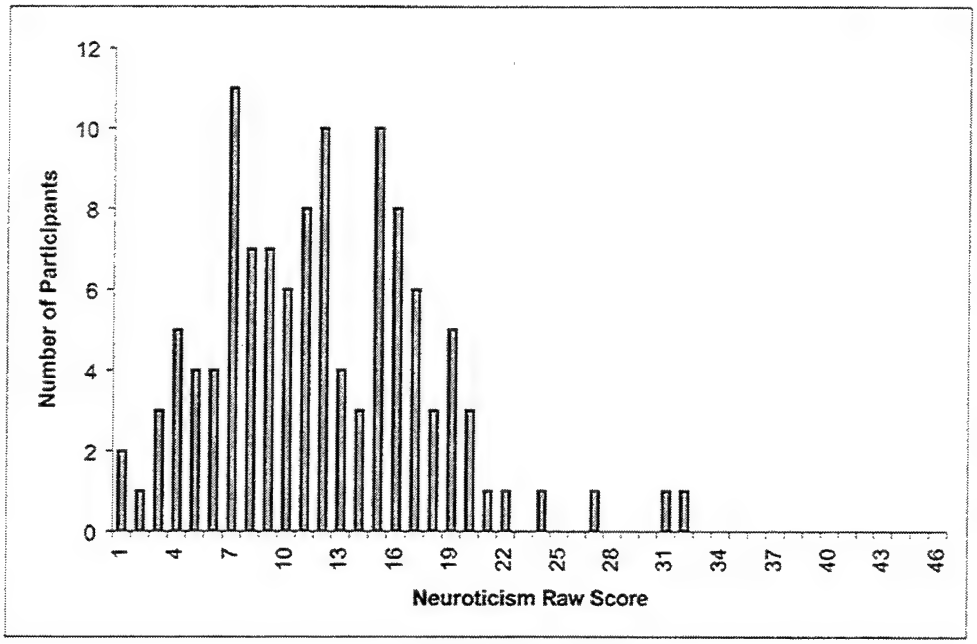

Figure 6. Frequency of Neuroticism Raw Scores

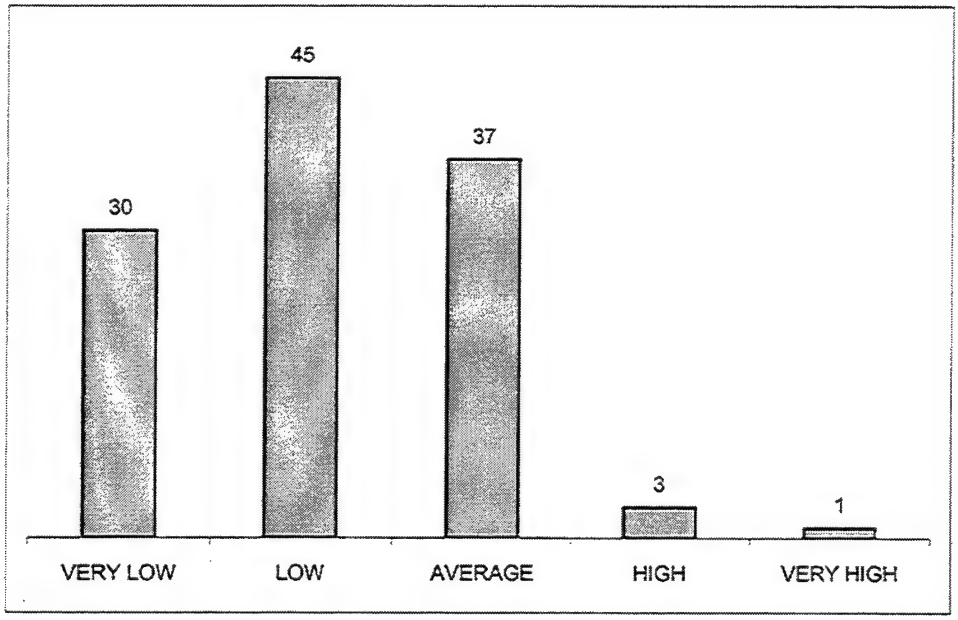

Figure 7. Distribution of Standardized Neuroticism Scores

Figure 8 is a histogram highlighting the distribution of participant expert ship-handler Extraversion scores. Figure 8 illustrates a negatively skewed distribution indicating that most participants possess large scores for Extraversion. Figure 9, a histogram delineating the breakdown of the Extraversion raw scores, communicates that most participant expert ship-handlers were higher than average in Extraversion. Approximately 80% of the participant expert ship-handlers possess a high or very high Extraversion personality characteristic.

Figure 10 is a histogram that displays the frequency of the observed Openness raw scores. Unlike Extraversion and Neuroticism, the participant expert ship-handlers appear to possess a symmetric distribution of Openness personality characteristics. Figure 11, the distribution of Openness classifications amongst the participants, appears to center around the average with an approximately normal distribution. 36% of all participant expert ship-handlers possess an average Openness personality characteristic while only 28% possess a low characteristic and only 22% possess a high Openness characteristic.

Figure 12 is a histogram illustrating the frequency of Agreeableness raw scores. Similar to Openness, Agreeableness also appears to be symmetrically distributed amongst the participant expert ship-handlers. However, as Figure 13 details, the majority of participants possess an average level of Agreeableness while only 27% possess a lower than average level and only 32% possess a higher than average Agreeableness personality trait.

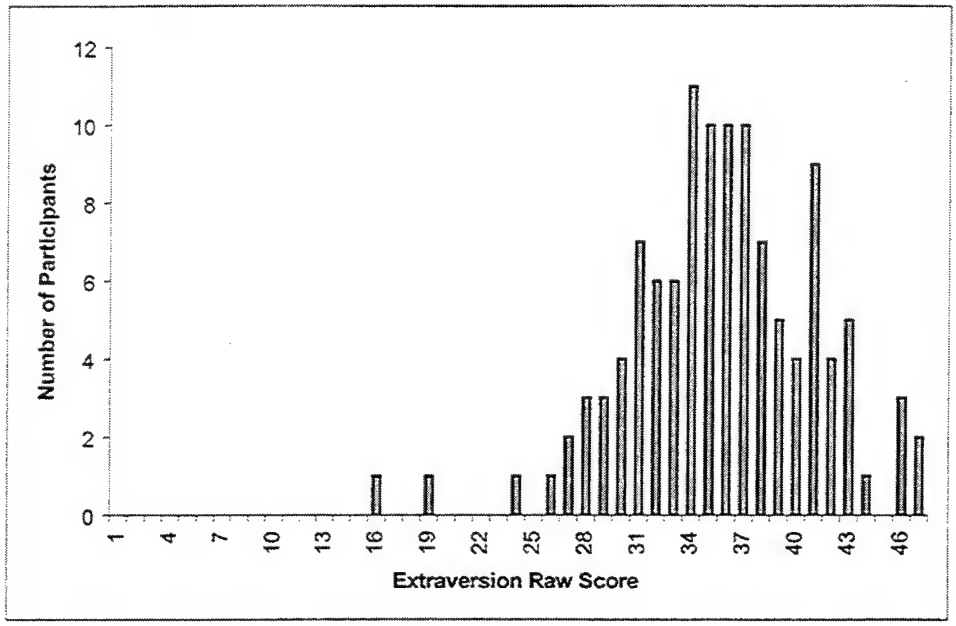

Figure 8. Frequency of Extraversion Raw Scores

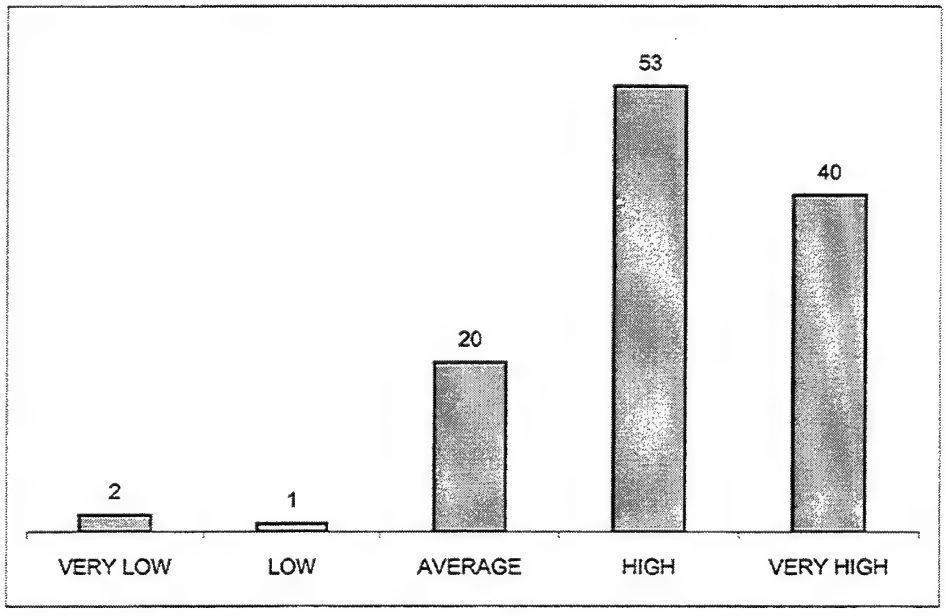

Figure 9. Distribution of Standardized Extraversion Scores

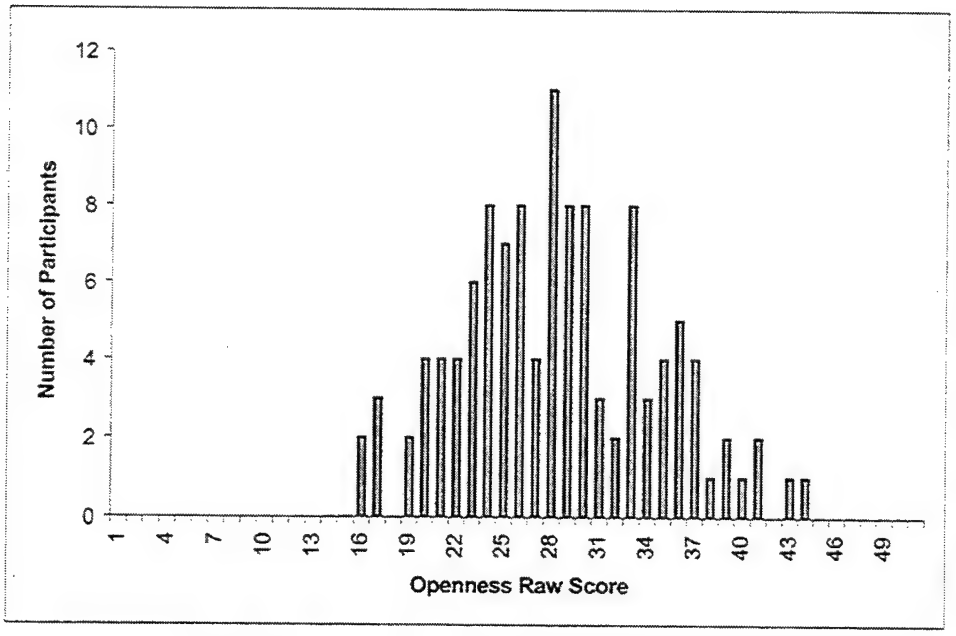

Figure 10. Frequency of Openness Raw Scores

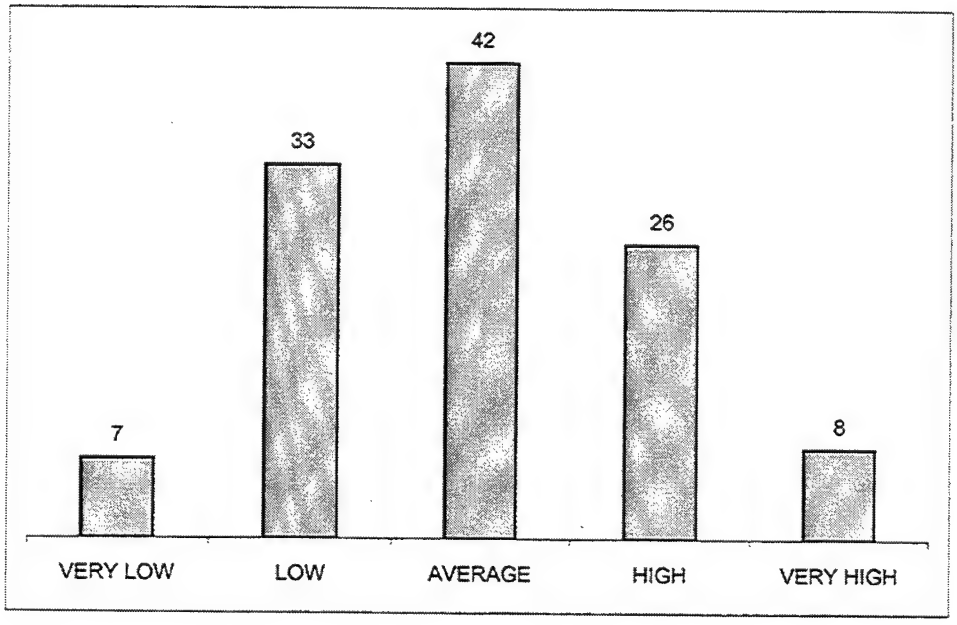

Figure 11. Distribution of Standardized Openness Scores

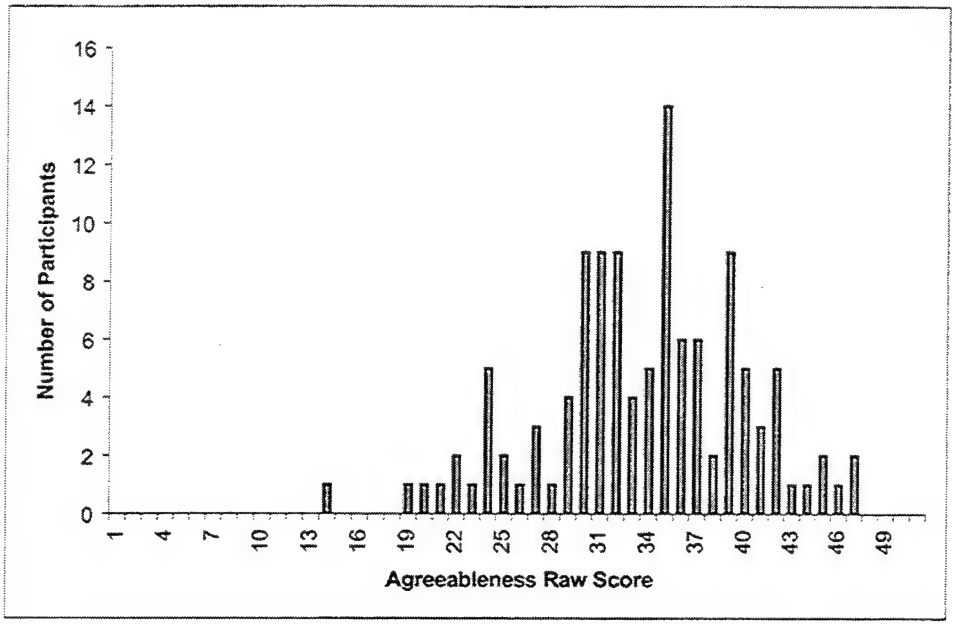

Figure 12. Frequency of Agreeableness Raw Scores

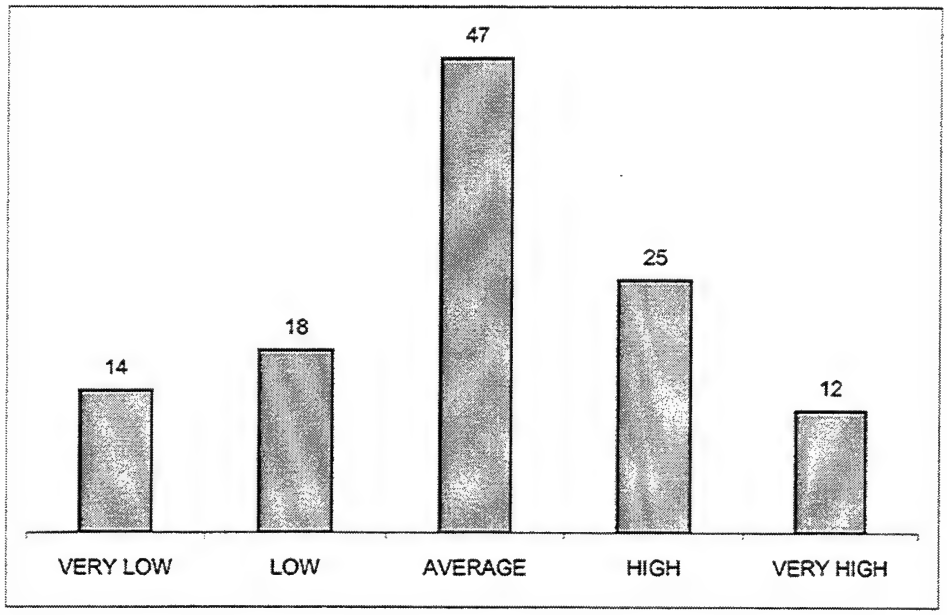

Figure 13. Distribution of Standardized Agreeableness Scores

Figure 14 is a histogram that displays the frequency of Conscientiousness raw scores. Conscientiousness appears to have a slightly negatively skewed distribution amongst the participant expert ship-handlers. Figure 15 showing the distribution of raw score classifications for Conscientiousness shows that 88% of all participants possess an average to very high Conscientious personality trait.

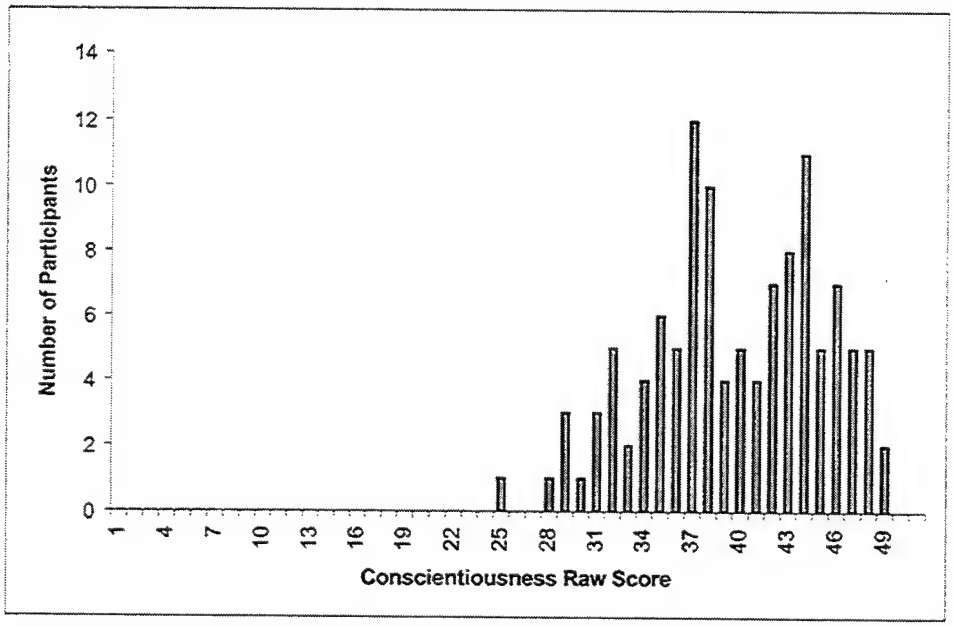

Figure 14. Frequency of Conscientiousness Raw Scores

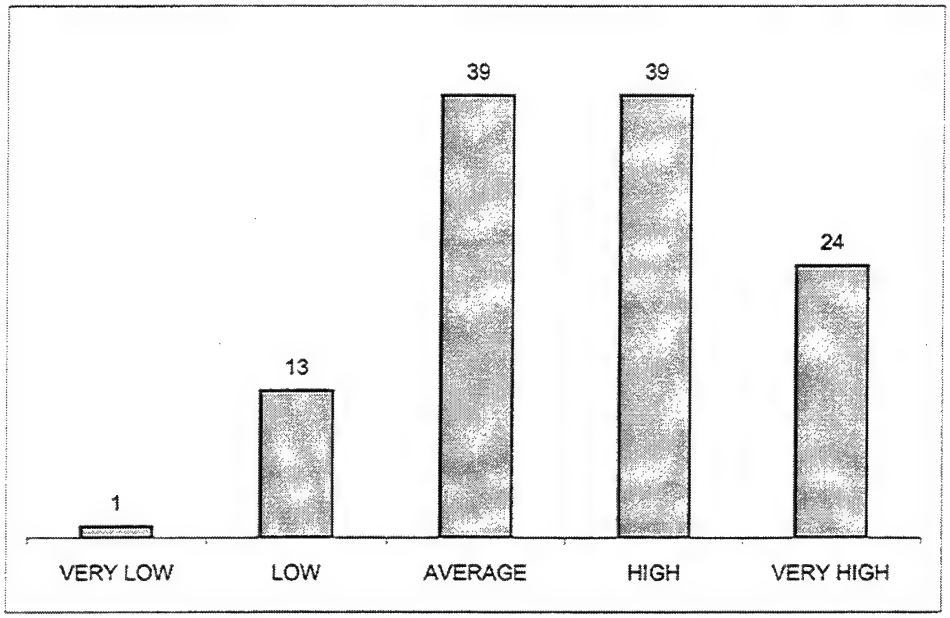

Figure 15. Distribution of Standardized Conscientiousness Scores

C. SHIP HANDLING EVALUATION SURVEY RESULTS

Figure 16 is a histogram that summarizes the overall participant expert ship-handler's preference for interaction. In general, the experts viewed the novice JO's ability to interact with other entities as a relatively import criteria for their evaluation of the JO's performance. 65% of all respondents felt that how the JO interacts is at least an important criterion for evaluation. Furthermore, these experts desired to coach their novices through the evolution via continuous input and feedback and their primary measure of interaction is how well the novice JO maintained close verbal communication with the expert ship-handler coach.

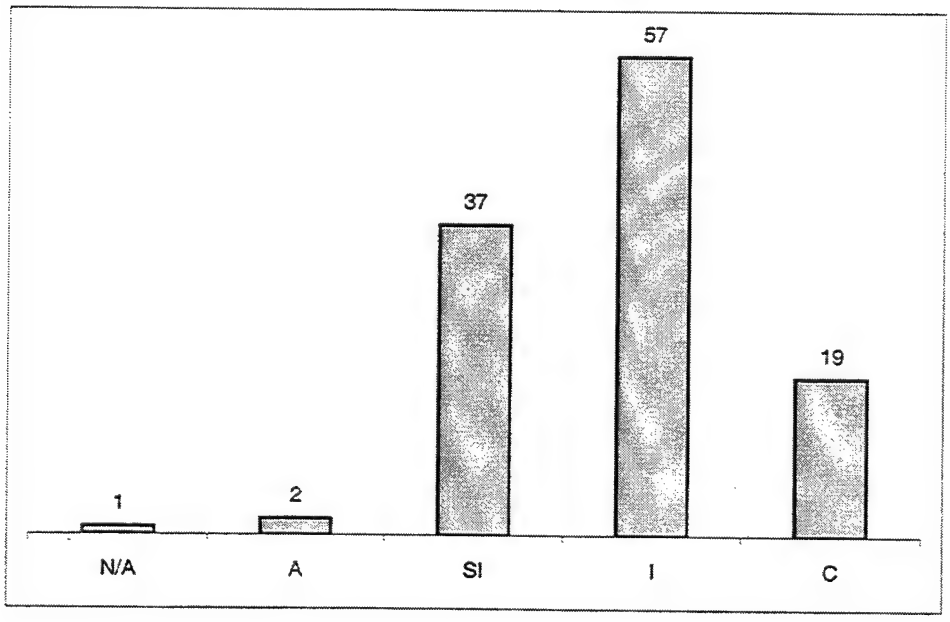

Figure 16. Distribution of Interaction Responses

Figure 17 is a histogram that summarizes the overall participant expert ship-handlers' preference for communication. The majority of experts did not feel that the novice JO's personal ability to communicate with the Replenishment ship was important to their evaluation of the JO's performance. Most expert ship-handlers feel that someone other than the novice JO performing the UNREP should handle personal communications between the approach ship and replenishment ship. Only 17% of all participants expressed communication as an important criteria for UNREP performance evaluation.

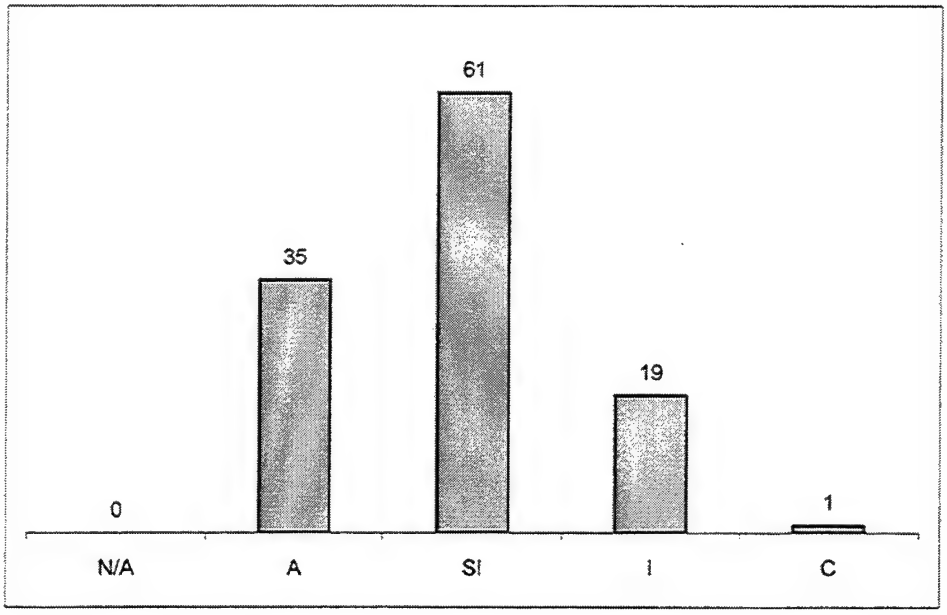

Figure 17. Distribution of Communication Responses

Figure 18 summarizes the participant expert ship-handlers' preference for analytical input. In general, most participant expert ship-handlers believe that a must be able to efficiently receive and process analytical information. While all participants believed that the novice JO's ability is at least somewhat important, 67% of all

respondents felt that analytical input is at least an important, if not critical component of evaluating the novice's performance.

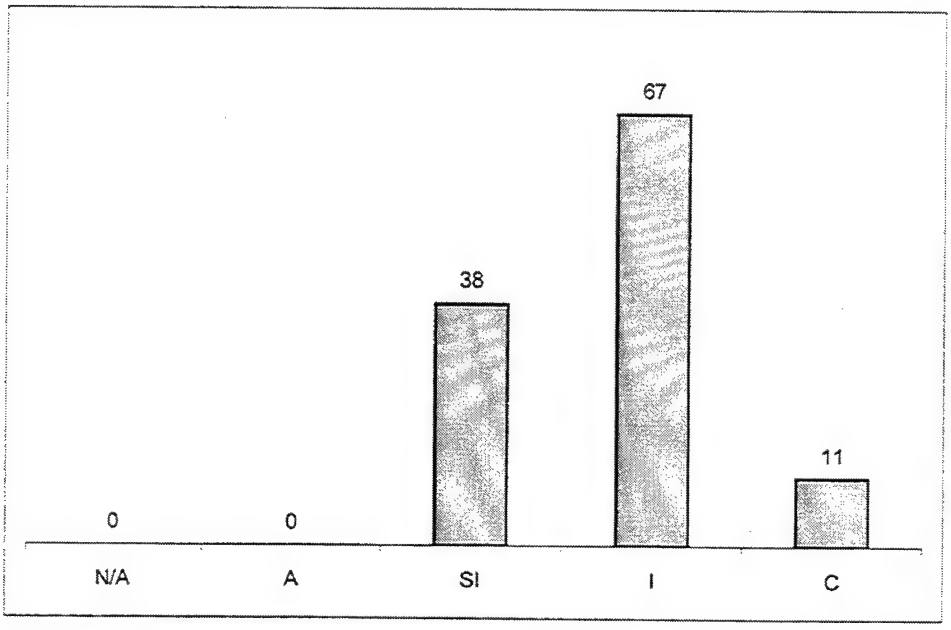

Figure 18. Distribution of Analytical Input Responses

Figure 19 summarizes the participant expert ship-handlers' preference for the novice JO to understand and efficiently process sensory input. All participants believed that the novice JO's ability to demonstrate an understanding of sensory input was at least somewhat important to the expert's overall evaluation. 35% of all participant expert ship-handlers view reaction to sensory information as a critical component of a successful UNREP and use the JO's response to sensory information as a major element of UNREP performance evaluation.

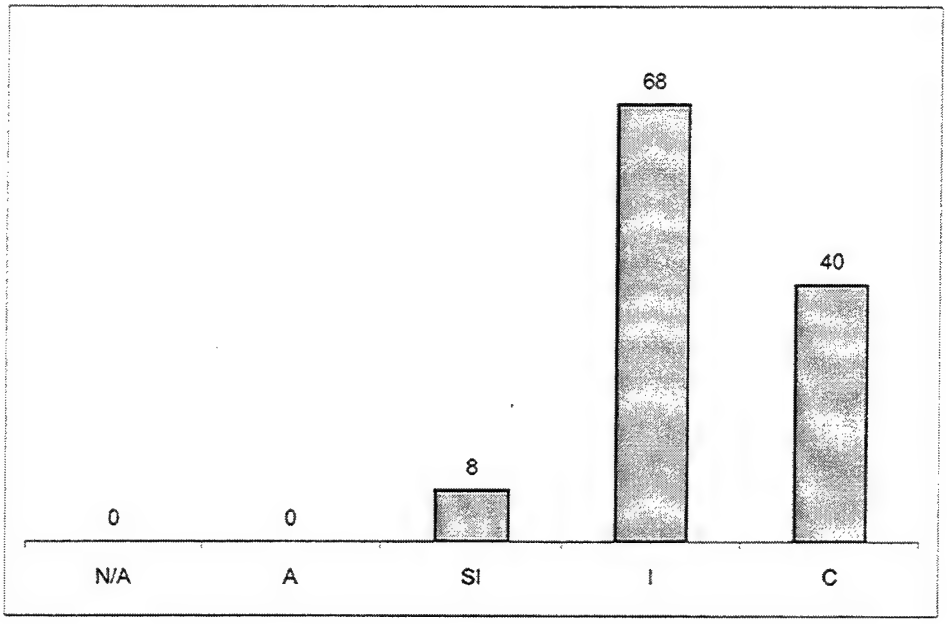

Figure 19. Distribution of Sensory Input Responses

Figure 20 is a histogram that provides a breakdown of how each individual participant expert ship-handler approaches UNREP. Figure 20 displays a uni-modal symmetric distribution with the majority of participant expert ship-handlers taking an attitude towards UNREP that is neither too flexible nor too strict. In general, most evaluators allow some deviations from their execution preferences by the novice JO. Only 7% require the novice to perform the evolution exactly as the expert desires while only 5% of all participant experts allow the JO to perform the UNREP in any safe manner.

The participant expert ship-handlers who tended towards a looser UNREP style placed less emphasis on time to perform the approach as a criterion for performance evaluation. In contrast, those experts who possess a more rigid UNREP style place more emphasis on time as an evaluation criterion. Regardless of UNREP style, most

participant expert ship-handlers believe that as experience increases, time to complete the evolution will decrease.

Approximately 50% of all participant expert ship-handlers believe that UNREP documentation and doctrine provides instruction that must be strictly adhered to. The other 50% of participant expert ship-handlers interpret UNREP documentation and doctrine as guidance that provides a flexible framework for execution.

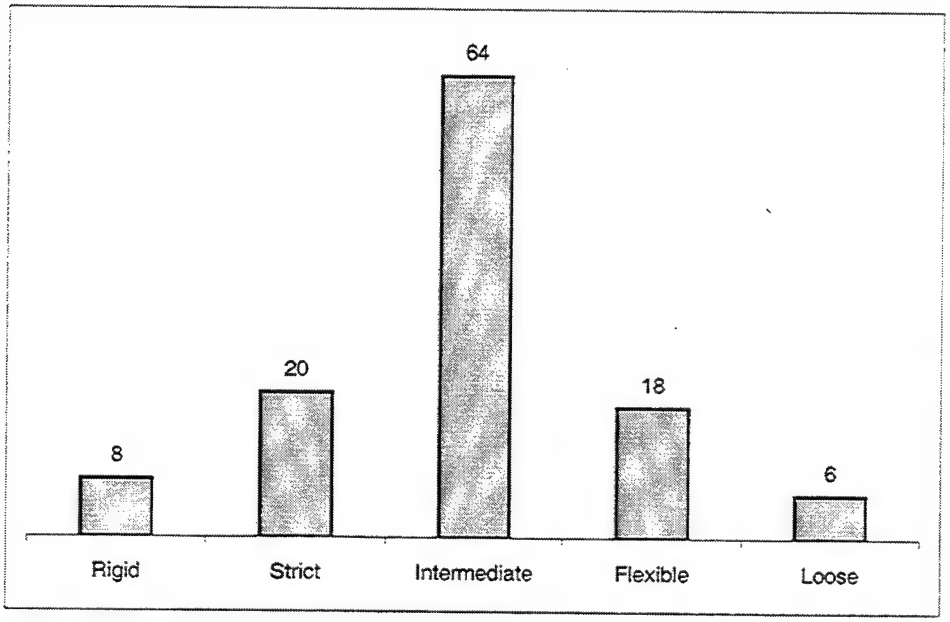

Figure 20. Distribution of UNREP Styles

D. OBSERVED CORRELATIONS

Table 5 contains the intercorrelations observed between the five personality factors measured by the NEO-FFI. Table 6 contains the average intercorrelations for the NEO-FFI [MCCR92]. In general, the personality traits were more intercorrelated for the participant expert ship-handlers than for the average NEO-FFI participant. The only

observed exceptions where the participants possessed lower than average intercorrelations were Neuroticism / Conscientiousness, Extraversion / Openness, and Agreeableness / Conscientiousness.

	N	E	O	A	C
Neuroticism		-0.55	-0.10	-0.44	-.37
Extraversion			0.16	0.31	0.38
Openness				0.09	-0.04
Agreeableness					0.09

Table 5. Observed NEO-FFI Intercorrelations for Participant Expert Ship-Handlers.

	N	E	O	A	C
Neuroticism		-0.21	-0.02	-0.25	-.53
Extraversion			0.40	0.04	0.27
Openness				0.02	-0.02
Agreeableness					0.24

Table 6. NEO-FFI Intercorrelations for Average Adults from the NEO-FFI Manual [MCCR92].

In general statistics, a large correlation exists if the correlation coefficient (ρ) is greater than or equal to 0.8 and a small correlation exists if ρ is less than or equal to 0.5. However, the intricacies of human behavior make analyzing real people more art than science. Single sample t-Test with a probability of type I error (α) equal to 0.10 indicate that correlations with ρ greater than 0.10 are significant for the participant expert ship-handler sample [DEVO95]. Therefore, for the purposes of this research, any correlation greater than or equal to 0.10 was identified as a potentially significant correlation.

Figure 21 graphically displays the calculated correlations between observed expert ship-handler Neuroticism values and measured UNREP evaluation criteria. In general, correlations were small in magnitude. All observed correlations were negative with the exception of the correlation between Neuroticism and Communication, which was only slightly positive.

Figure 22 contains information describing the calculated correlations between expert ship-handler Extraversion values and measured UNREP evaluation criteria. In contrast with the Neuroticism correlations, most Extraversion correlations were positive with the exception of the correlation between Extraversion and UNREP style. The only apparent significant correlation was observed between Extraversion and Sensory Input (ρ = .18). This relationship could possible be explained by Sensory Input satisfying the extroverts need for stimulation from his surroundings [MCCR92].

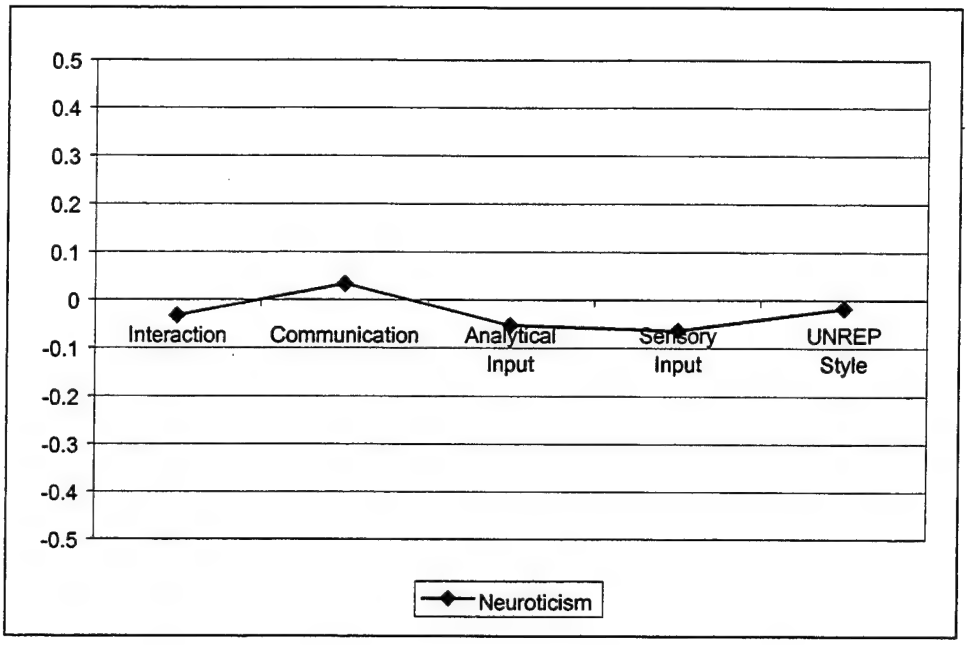

Figure 21. Correlations between Neuroticism and UNREP Evaluation Criteria for Participant Expert Ship-Handlers

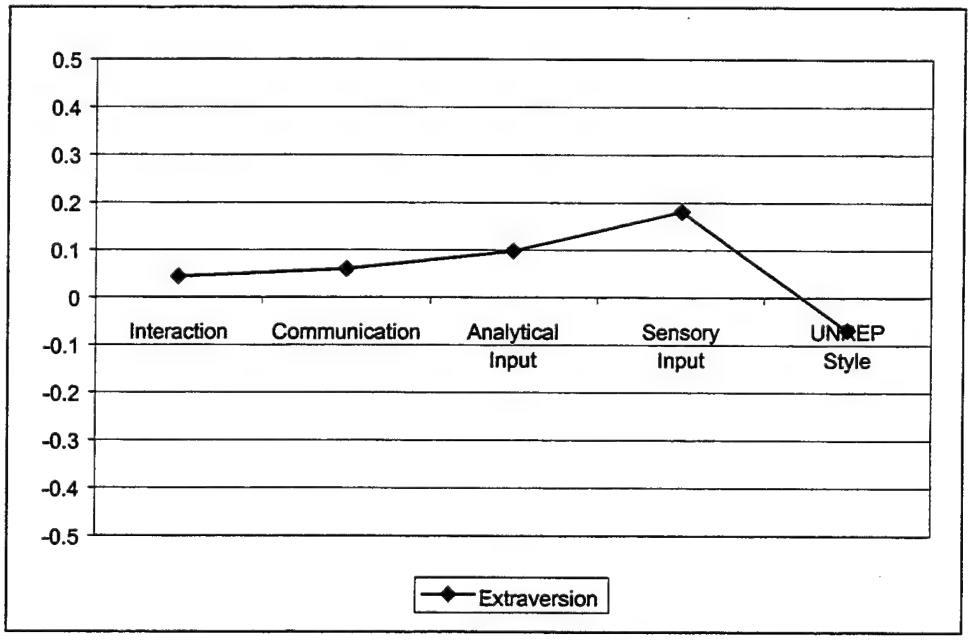

Figure 22. Correlations between Extraversion and UNREP Evaluation Criteria for Participant Expert Ship-Handlers

Figure 23 highlights the correlations calculated between the observed expert ship-handler Openness personality characteristic and the measured UNREP evaluation criteria. All calculated correlations for Openness were positive. Furthermore, all correlations were only slightly positive with the exception of the correlation between Openness and Analytical Input ($\rho = .16$) and Openness and UNREP Style ($\rho = .16$). This result might be related to the modest association between Openness and measured intelligence since Analytical Input is more calculation based. Therefore, it is possible that an expert that is higher in Openness would tend to more analytical or cognitive intensive methods. However, it must be clear that Openness is not a measure of analytical sense or actual intelligence [MCCR92].

Figure 24 delineates the correlations calculated between the observed expert ship-handler Agreeableness personality characteristic and the measured UNREP evaluation criteria. All calculated correlations were positive with the exception of the correlation between Agreeableness and Communication, which was slightly negative. The only apparent significant correlation was observed between Agreeableness and UNREP Style ($\rho = .16$). A potential explanation for this correlation is that the highly agreeable person is sympathetic to others and eager to help, resulting in an UNREP style that is more malleable to the trainee novice [MCCR92]. The expert who scores high in Agreeableness sees the UNREP as a training evolution for the novice and therefore has a less rigid UNREP style resulting in greater variability and less structure in order to let the novice learn from exploration.

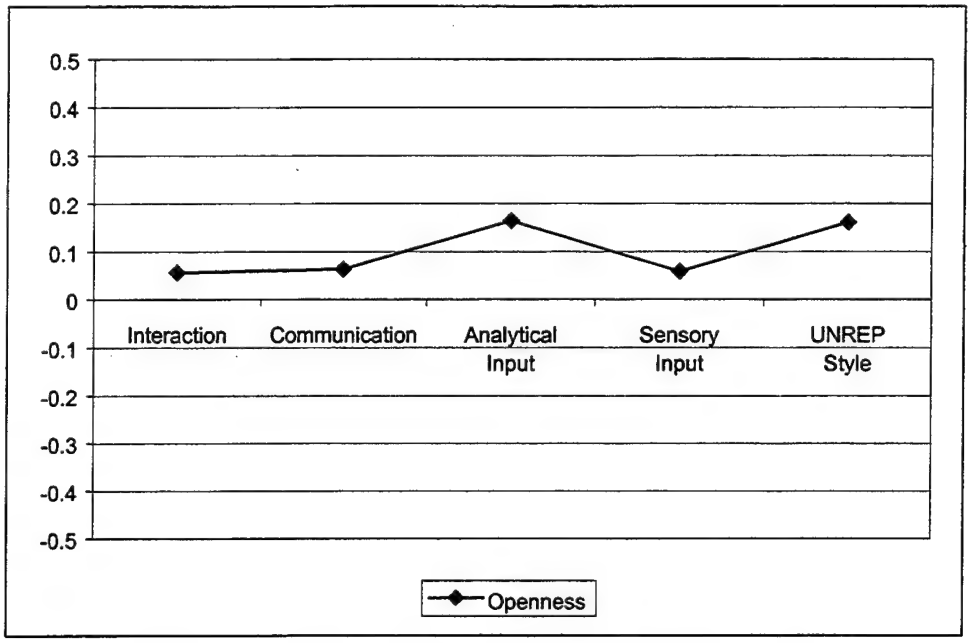

Figure 23. Correlations between Openness and UNREP Evaluation Criteria for Participant Expert Ship-Handlers

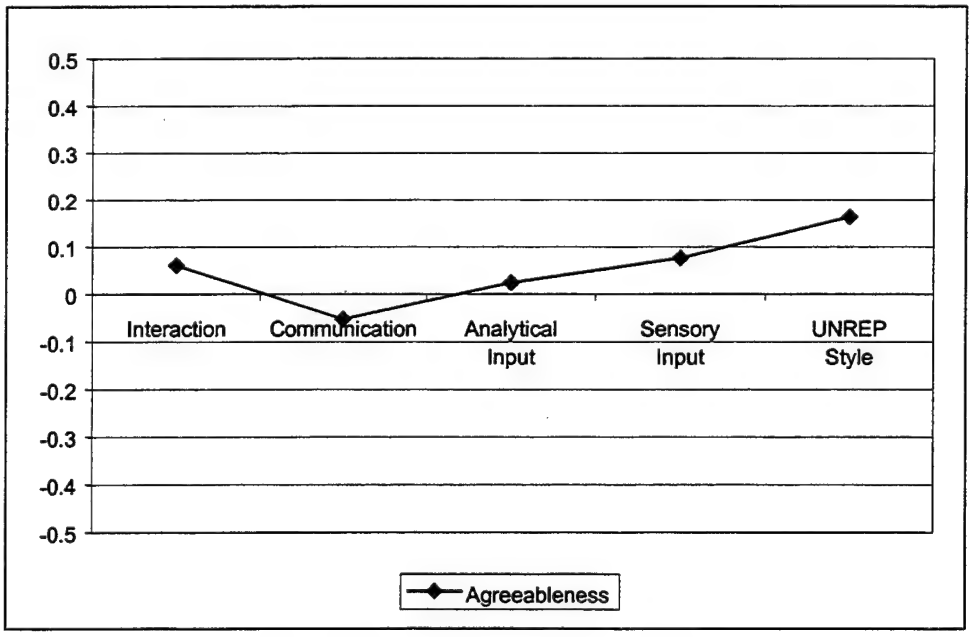

Figure 24. Correlations between Agreeableness and UNREP Evaluation Criteria for Participant Expert Ship-Handlers

Figure 25 graphically displays the correlations calculated between the observed participant expert ship-handler Conscientiousness personality trait and the measured UNREP evaluation criteria. Similar to the Openness correlations, all calculated Conscientiousness correlations were positive. However, two significant correlations existed between Conscientiousness and Analytical Input ($\rho = .17$) and Conscientiousness and Sensory Input ($\rho = .39$). The correlation between Conscientiousness and Sensory Input was the highest observed over the entire experiment. Experts who score high in Conscientiousness are usually purposeful and strong willed and are often associated with academic and occupational achievement [MCCR92]. These facts can be directly linked to the expert ship-handler's priority to properly processing all forms of information input. The highly conscientious expert will not be able to ignore any information that may affect the UNREP, regardless of source.

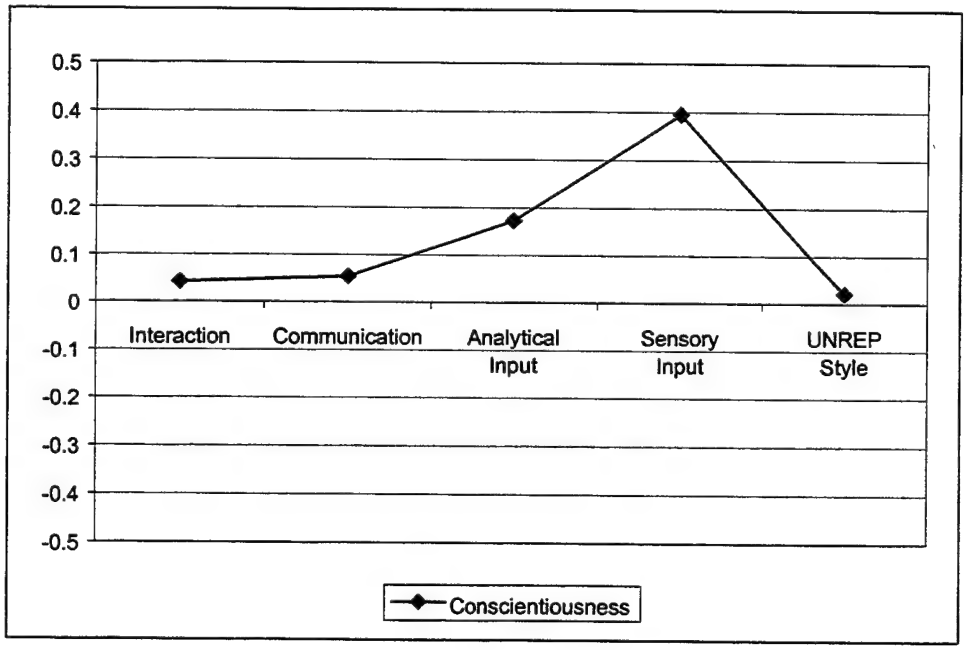

Figure 25. Correlations between Conscientiousness and UNREP Evaluation Criteria for Participant Expert Ship-Handlers

Correlations were also calculated to determine if there was any relationship between the participant expert ship-handlers' NEO-FFI personality traits and Tenney's VCO profiles [TENN99]. Figure 26 illustrates the relationships between the measured participant personality traits and Tenney's Passive VCO profile. Significant correlations existed between the Passive VCO profile and the Agreeableness (ρ = -.25) and Conscientiousness (ρ = -.11) personality traits. In direct contrast, Tenney's Proactive VCO profile correlated with Neuroticism (ρ = -.20), Extraversion (ρ = .13), and Openness (ρ = -.11). Figure 27 illustrates these correlations.

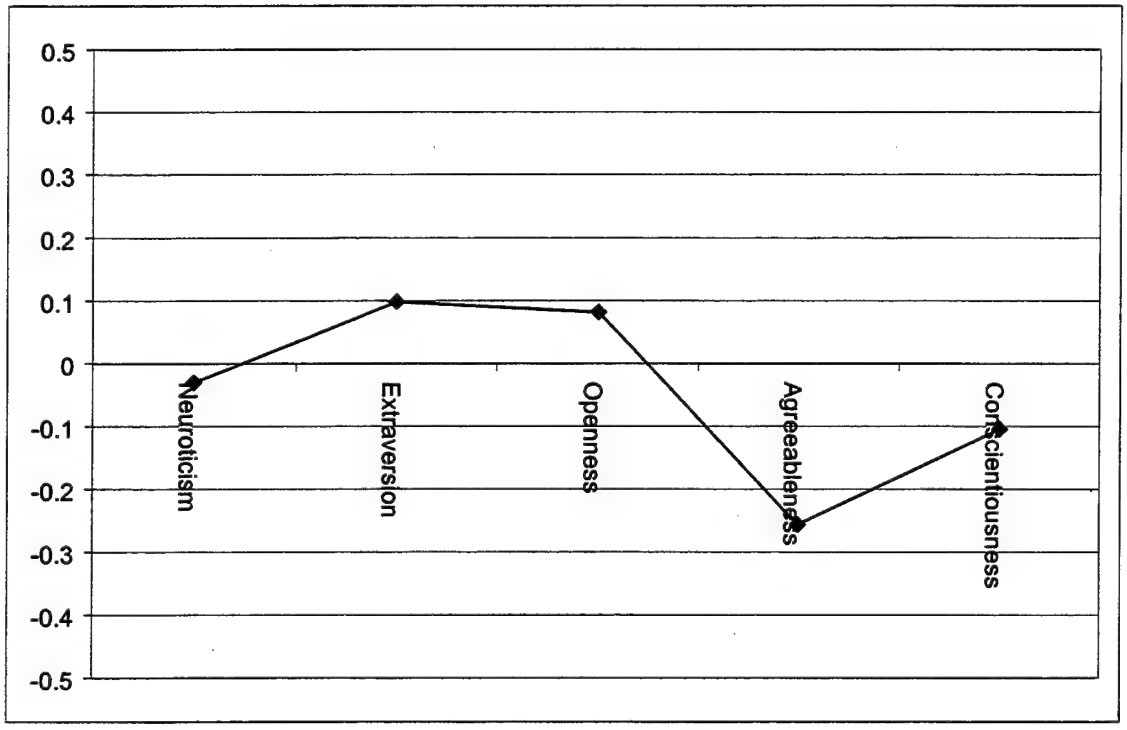

Figure 26. Calculated Correlation Between Observed Participant Expert Ship-Handler NEO-FFI Personality Traits and Tenney's Virtual Commanding Officer Passive Profile.

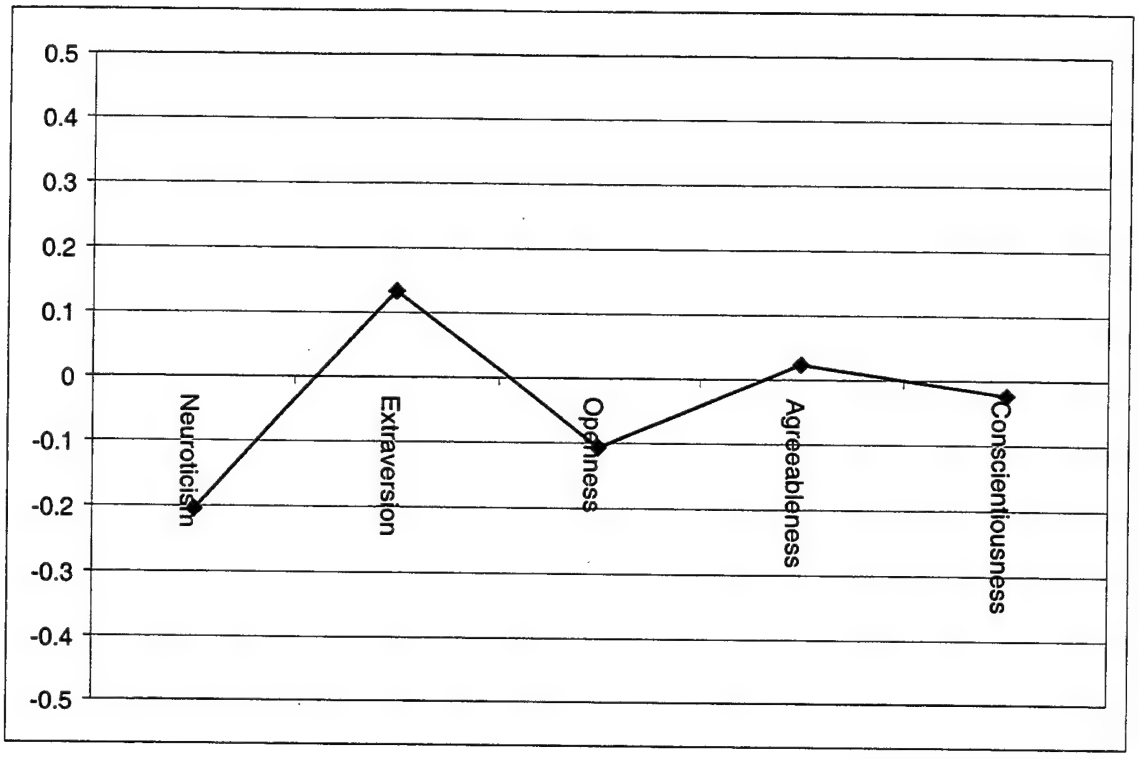

Figure 27. Calculated Correlation Between Observed Participant Expert Ship-Handler NEO-FFI Personality Traits and Tenney's Virtual Commanding Officer Proactive Profile.

E. DISCUSSION

Due to the assistance of Vice Admiral Giffin and Vice Admiral Moore, 40 percent of all expert ship-handlers queried responded to the survey. This relatively high participation rate greatly increased the quality of the data package by producing relatively normal distributions for all areas analyzed. Indications are that the sample of participant expert ship-handlers is a decent approximation of the expert ship-handling population. Furthermore, the wide range of responses created a broader depth of elicitated ship-

handling knowledge that will directly translate into a better database for COVE programmers.

Analysis of the participant expert ship-handler data package indicates that the surveyed experts possess some significant differences from the average adult. In general, experts were lower in Neuroticism, and higher in Extraversion and Conscientiousness. It is clear that whenever modeling an expert ship-handler, close attention needs to be focused towards the expert's level of Neuroticism, Extraversion, and Conscientiousness to ensure that the expert behaves in a manner that is consistent with expertise. Future research will verify that these personality characteristics apply to all experts regardless of the domain of expertise.

It is important to note that there is still room for variability in an expert model's personality. While the means for participant expert ship-handler levels of Neuroticism, Extraversion, and Conscientiousness were significantly different from the average adult population, Figure 5 illustrates that the standard deviations for the participant expert ship-handlers' personality traits were very close to the average adult standard deviations. This indicates that experts can vary in personality just as much as the average person does, just within a different range.

In addition to the model of expert personality, close attention should be focused towards the dynamic of expert evaluation of a novice. All ship-handling experts are going to evaluate novice performance based upon a unique combination of evaluation criteria. The evaluation criteria create a performance checklist that the novice is evaluated against and will consist of a combination of Interaction Responses, Communication Responses, Analytical Input Responses, Sensory Input Responses, and

the evaluator's UNREP Style. The emphasis and priority of this novice report card is related to the evaluator's individual personality. Analytical Input will be stressed if the expert evaluator is relatively high in either Openness or Conscientiousness. Sensory Input will be a critical criterion if the expert possesses a relatively large amount of Extraversion or Conscientiousness. Finally UNREP style will be a major performance criterion if the expert ship-handler performing the evaluation scores high in Openness or Agreeableness.

Analysis of the data package also indicates that there are links between Tenney's VCO profiles and the model of expert personality proposed in this research. Experts who are relatively low in Agreeableness and Conscientiousness will tend towards a more passive style of ship-handling as defined by Tenney's previous work. Furthermore, and in direct contrast, expert ship-handlers who display relatively high Extraversion and relatively low Neuroticism and Openness will tend towards Tenney's proactive VCO profile.

With the proper composition of personality traits, and proper combination of evaluation criteria and overall ship driving style, a relatively robust model of an experienced evaluator of ship-handling is developed. The model is robust because it covers a relatively wide range of personality inputs resulting in a potentially wide range of unique prototype expert ship-handlers. With proper development, the model born from this research could potentially grow into an accurate representation of human mentoring.

VI. CONCLUSIONS

A. SUMMARY OF WORK

Understanding how experts evaluate performance of tasks with large degrees of variability is a difficult undertaking. Just like the tasks themselves, the evaluation does not always have the same clear-cut criteria for each expert performing the evaluation. Often, critical evaluation criteria are as individualistic as the evaluating individual.

The primary purpose of this thesis was to assess the relationship between an expert evaluator's personality and the evaluation criteria the expert employed. COVE's UNREP trainer, currently under development by NAWC-TSD, provided the ideal vehicle for this research since UNREP is a highly dynamic and challenging task performed by a novice whose performance evaluation is often a combination of unique objective and subjective criteria dependent upon the evaluating expert.

In order to obtain information about the relationship between evaluation and personality, a review was performed on various topics including facets of personality, decision-making, individual differences, differences between experts and novices, and personality measurement. This review was a crucial step for selecting the proper personality assessment tool. Next, an experiment package was developed utilizing a questionnaire format in order to elicit information about personality, ship-handling style, and novice performance evaluation by a ship-handling expert.

After the experiment package was developed, the survey was administered to ship-handling experts resident in the fleet. Support from both Commander Surface Naval Forces Atlantic, Vice Admiral Giffin, and Commander Surface Naval Forces Pacific, Vice Admiral Moore was critical in ensuring adequate participation by busy ship-handling experts. With their help, 116 experts participated in the survey either via a paper based or web based version.

After the end of the data collection period, the participant surveys were collated into a data analysis package. The data was analyzed for statistical summary information such as means, minimum values, maximum values, mode, median, and standard deviations. The data was also analyzed for significant correlations existing between participant expert ship-handler personality traits and participant expert ship-handler evaluation criteria and ship driving style. Correlations were also analyzed between personality and Tenney's VCO profiles.

Understanding performance evaluation is a goliath work in progress. Results of this research, while beginning to explore the gray areas of variability in evaluation, will provide direct enhancement to the training potential of COVE by increasing the fidelity of COVE's ITS. The insights gained from the expert ship-handler personality traits will increase the social realism of the ITS and therefore improve the manner of feedback given to the trainee since the ITS can now respond in a more human manner. Furthermore, the compilation of critical evaluation criterion and its relationship to personality will enhance the task training ability of COVE since it will allow the ITS to train in a manner similar to fleet experts. Finally, the creation of a ship-handling database for various fleet expert

ship-handlers will provide a solid footing for the overall future development and performance of COVE, increasing its quality as a training tool and its utility to the fleet.

B. THESIS QUESTIONS

The following questions were addressed in this thesis:

- Is there a relationship between one's personality and one's expertise?

Analysis of the NEO-FFI personality inventory administered to the participant expert ship-handlers indicates that there is a relationship between personality and expertise. In general, inventoried experts were less neurotic and more extroverted and conscientious than the average adult. Inventoried experts possess levels of Openness and Agreeableness that do not deviate from expected norms for the average adult.

- If such a relationship exists, can it be quantified?

The model of an expert's personality should possess the same levels of Openness and Agreeableness observed in the average adult, centering primarily around average with an approximately normal distribution. When modeling an expert's personality, Neuroticism should range

from between very low to average with only a small percentage of experts possessing higher than average Neuroticism. In contrast, the expert personality model should possess levels of Extraversion primarily ranging between high and very high with a lower percentage of average extroverts. Finally, the expert personality model should possess a primarily average or high level of conscientiousness.

- Does it extend beyond individual expertise to the expert's evaluation of others' performance?

Analysis of the ship handling evaluation portion of the expert survey indicates that there is a relationship between personality and the evaluation of performance. Evaluation of the novice is based upon a combination of factors including proficiency of Interaction, Communication, processing of Analytical and Sensory Input, and level of adherence to the evaluator's stylistic tendencies as displayed by the novice. The combination of these factors is unique for different experts and is dependent upon the expert's personality profile.

- What is the range of characteristics of different ship driving styles?

The data collected during the ship-handling survey spans a wide range of ship-handling variability and will be collated and sent to NAWC-TSD COVE programmers for analysis.

The overall data gathered for this experiment serves as a basis for the programming of an ITS for COVE. With this research, a database now exists where a programmer can create a model of ship-handling expertise that is highly variable depending upon user input. If done correctly, the user could configure a personality profile that results in a VCO that interacts, evaluations, and provides feedback to the trainee in a way that is completely unique to the personality configuration.

The relationship between personality, expertise, and evaluation proposed in this thesis will allow the ITS to perform in a more human-like manner, increasing the illusion of immersion for the trainee, and provide the trainee with accurate performance evaluation criteria, increasing the positive training transfer benefits. In addition to information about expertise and evaluation, specific information was gathered regarding preferences for acceptable UNREP performance. This information will aid programmers in determining acceptable limits and bounds for trainees to perform within.

An important point is that this research is entirely limited to COVE and UNREP evolutions. While this research utilized surface ship-handling and COVE as a vehicle, the real road is how experts subjectively evaluate highly aggregate tasks such as UNREP. The theories and model of expertise provided by this research can potentially span across any domain of expertise, as long as the expertise is not composed of black and white levels of performance and evaluation.

C. RECOMMENDATIONS FOR FUTURE WORK

Tenney's initial research, combined with the efforts of this research, is a start for improving the man-machine interface of tomorrow's computer based trainers. Continuance of this research could vector into numerous directions. Some possibilities of future work include:

- Further investigation between Tenney's VCO profiles and their relationship to an expert's personality.
- A further analysis of the data obtained from this experiment utilizing expert ship class as a variable
- Examining the dynamic between expert and novice accounting for the personality of the expert as well as the personality of the novice.
- A linear, or non-linear, regression model of evaluation with coefficients based upon the correlations proposed in this research.
- An agent based autonomous agent, such as STEVE, that possesses a configurable personality within the bounds of expert personality as defined by this research.

Understanding the intricacies of human behavior and its relationship to highly aggregate tasks that are subjectively evaluated is a mammoth effort. Hopefully, this is only the beginning of a series that attempts to quantify how humans act and react. Performance of this type of research is a critical step in increasing the utility of computers by making a computer more like a human instead of a human more like a computer.

APPENDIX A. COMMANDER, SURFACE NAVAL FORCES ATLANTIC ENDORSEMENT

COMMANDER NAVAL SURFACE FORCE
U.S. ATLANTIC FLEET

8 May 2000

Dear Commanding Officers,

The Naval Postgraduate School (NPS) maintains a proud tradition of serving as a "Tech Bridge", accommodating advanced research in direct support of Navy goals and future development. The Conning Officer Virtual Environment (COVE) program is a prime example of how NPS research strives to take Technical back to Tactical. Cove is a surface ship-handling trainer that utilizes cutting edge computer graphics and physically based modeling to simulate the ship driving experience. COVE is scheduled for imminent release to SWOS and the fleet. (A year plus).

The enclosed survey is part of an NPS thesis that directly supports COVE. The survey seeks to increase the fidelity and realism of interactions between the COVE trainer and the student. By completing this survey, your time will improve the quality of this 21st century readiness tool.

Thanks!

Sincerely,

This is to help the NPGS and establish personality trait of our COs. The questions are somewhat unusual, but will help the intelligent tutoring system. It is anonymous. Appreciate your time.

HENRY C. GIFFIN III
Vice Admiral, U.S. Navy

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APPENDIX B. COMMANDER, SURFACE NAVAL FORCES PACIFIC ENDORSEMENT

COMMANDER NAVAL SURFACE FORCE
U.S. PACIFIC FLEET

12 May 2000

Dear Commanding Officer,

Naval Postgraduate School (NPS) maintains a proud tradition of serving as a "Tech Bridge," accommodating advanced research in direct support of Navy goals and future development. The Conning Officer Virtual Environment (COVE) program is a prime example of how NPS research strives to take technical back to tactical. COVE is a surface ship-handling trainer that utilizes cutting edge computer graphics and physically based modeling to simulate the ship driving experience. COVE is scheduled for imminent release to SWOS and the fleet. (within one year +)

The enclosed survey is part of a NPS thesis that directly supports COVE. The survey seeks to increase the fidelity and realism of interactions between the COVE trainer and the student. By completing this survey, your time will improve the quality of this 21st century readiness preparation tool.

Captains —
Don't worry over the negative "social science" wording of some of the personality profile questions. Only the researchers at NPS will have access to your responses. EDW

Sincerely,

EDWARD MOORE, JR.
Vice Admiral, U.S. Navy

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APPENDIX C. EXAMPLE ADDENDUM TO INSTRUCTIONS

From: LT. Chris Buziak
To: COMMANDING OFFICER, USS BONHOMME RICHARD (LHD 6)
Subj: ADDENDUM INSTRUCTIONS FOR EXPERT SHIPHANDLER SURVEY

This survey is now available on the Internet. You are encouraged to participate in the web based version by typing the following address into the Address Bar *(Internet Explorer, Figure 1)* or into the Location Bar *(Netscape Communicator, Figure 2)*:

http://www.nps.navy.mil/coves/Experiment

The ACCESS CODE to gain entry into the web site is: **Moves** *(case sensitive)*.

If you choose to participate in the web based version, you are not required to return the survey packet. Regardless of format, please complete the survey no later than **July 1, 2000**.

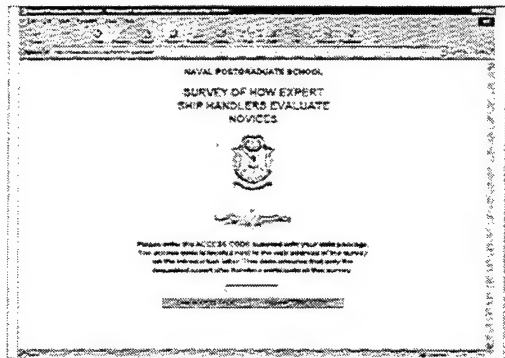

Figure 1:
Example Title Screen as viewed by Internet Explorer

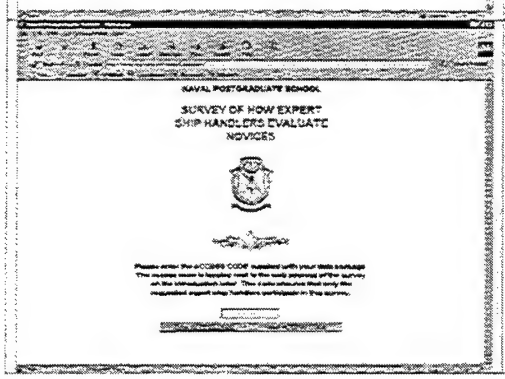

Figure 2:
Example Title Screen as viewed by Netscape Navigator

Very Respectfully Submitted,
LT. Chris Buziak

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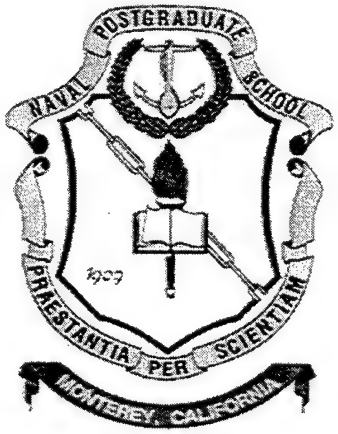
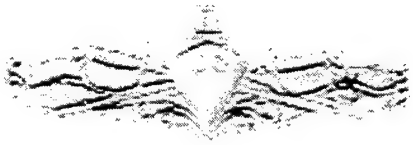
APPENDIX D. EXPERT SHIP-HANDLING EVALUATION SURVEY

NAVAL POSTGRADUATE SCHOOL

SURVEY OF HOW EXPERT SHIP HANDLERS EVALUATE NOVICES





NAVAL POSTGRADUATE SCHOOL

SURVEY OF HOW EXPERT SHIP HANDLERS EVALUATE NOVICES

INTRODUCTION

Why Should I Participate?

Based upon your experience and current position, you were identified as an expert ship handler. Your participation with this survey will ensure that certain aspects of simulator training are realistic and pertinent and that simulator-training systems are capable of instructing trainees in a similar fashion to how you instruct your Junior Officers.

COVE Simulator

This survey supports development of the Conning Officer Virtual Environment (COVE), ship-driving simulator scheduled for imminent release to both SWOS and the fleet. COVE is a fully funded training project being developed by NPS, Naval Air Warfare Center Training Systems Division (NAWCTSD), and the Office of Naval Research (ONR).

COVE allows junior ship drivers the opportunity to practice dangerous ship handling evolutions on a shore-based facility with no danger to material or personnel.

Privacy Information

Your anonymity is maintained at all times throughout this survey, and your privacy is safeguarded under OPNAV Instruction 3900.39B. There is no record linking your participation with this survey. A record of the information contained in the experiment described herein will be retained permanently at the Naval Postgraduate School or by higher authority. Answers provided by your participation will be used only for statistical analysis by the Departments of the Navy and Defense, and other U.S. Government agencies, provided this use is compatible with the purpose for which the information was collected.

By participating in this survey, you acknowledge that you understand that your privacy is maintained as stated above. Furthermore, you are acknowledging that your participation is completely voluntary.

INSTRUCTIONS

How To Complete This Survey

We know that your time is valuable. This survey should take approximately **30 minutes** to complete. The survey consists of three parts:

1) Professional demographic section
2) Personality inventory
3) UNREP evaluation section.

Completion of this survey will require you to either fill in blank response fields or complete a multiple choice by circling your answer. Please answer every question in this survey to the best of your ability. If there are any problems with this survey, please contact:

LT. Chris Buziak, USN[1]
Code 32, Naval Postgraduate School
833 Dyer Road, Rm 404
Monterey, CA 93943-5000
(831) 656-4679
DSN 878-4679

Upon completion, please return the survey in the enclosed envelope to the above address.

Thank you for your time and participation.

[1] Email any questions to LT. Chris Buziak at buziak@cs.nps.navy.mil

PROFESSIONAL DEMOGRAPHICS

Rank:	
Primary Warfare Specialty: *(circle one)*	Surface Aviation Submarine Other
Age:	
Sex: *(circle one)*	Male Female
Total Years of Officer Service:	
Number of years in a sea billet: *(Total)*	
Number of Commanding Officers you have served under while at sea:	
Current Sea Billet: *(If at shore, fill in* SHORE*)*	
Current Class of Ship: *(If at shore, fill in* SHORE*)*	
Time since last at sea: *(Months)*	
Approximate Number of UNREP Approaches (Total during your career): *(circle one)*	0 – 50 51 – 100 101 – 200 200 - 299 More Than 300

PERSONALITY INVENTORY

Instructions

This section of the survey consists of a short, 60 question, personality inventory. This personality inventory is a standardized professional psychological tool that NPS is utilizing to learn more about the experts residing in the fleet. NPS believes that accurate modeling of expert leadership will enhance the fidelity of the COVE trainer. The inventory takes approximately **10 minutes** to complete. Please answer all of the following 60 questions as accurately and truthfully as possible selecting an answer that best represents your opinion. Try not to read too much into any question. Your first impression or thought after reading the question should be your answer. Do not go back and change a previous answer. Possible answers range from strongly disagree in the leftmost column to strongly agree in the rightmost column.

(SD) ***Strongly Disagree*** or the statement is definitely false
(D) ***Disagree*** if the statement is mostly false
(N) ***Neutral*** if you cannot decide, or the statement is equally true and false
(A) ***Agree*** or the statement is mostly true
(SA) ***Strongly Agree*** or the statement is definitely true

Choose only one answer per question. There is no time limit.

Inventory

Question	SD	D	N	A	SA
1. I am not a worrier.					
2. I like to have a lot of people around me.					
3. I don't like to waste time daydreaming.					
4. I try to be courteous to everyone I meet.					
5. I keep my belongings clean and neat.					
6. I often feel inferior to others.					
7. I laugh easily.					
8. Once I find the right way to do something, I stick to it.					
9. I often get into arguments with my family and co-workers.					
10. I'm pretty good about pacing myself so as to get things done on time.					
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.					
12. I don't consider myself especially "light-hearted".					
13. I am intrigued by the patterns I find in art and nature.					
14. Some people think I'm selfish and egotistical.					
15. I am not a very methodical person.					
16. I rarely feel alone or blue.					
17. I really enjoy talking to people.					

(SD) ***Strongly Disagree*** or the statement is definitely false
(D) ***Disagree*** if the statement is mostly false
(N) ***Neutral*** if you cannot decide, or the statement is equally true and false
(A) ***Agree*** or the statement is mostly true
(SA) ***Strongly Agree*** or the statement is definitely true

Question	SD	D	N	A	SA
18. I believe letting students hear controversial speakers can only confuse and mislead them.					
19. I would rather cooperate with others than compete with them.					
20. I try to perform all the tasks assigned to me conscientiously.					
21. I often feel tense and jittery.					
22. I like to be where the action is.					
23. Poetry has little or no effect on me.					
24. I tend to be cynical and skeptical of others' intentions.					
25. I have a clear set of goals and work toward them in an orderly fashion.					
26. Sometimes I feel completely worthless.					
27. I usually prefer to do things alone.					
28. I often try new and foreign foods.					
29. I believe that most people will take advantage of you if you let them.					
30. I waste a lot of time before settling down to work.					
31. I rarely feel fearful or anxious.					
32. I often feel as if I'm bursting with energy.					
33. I seldom notice the moods or feelings that different environments produce.					
34. Most people I know like me.					
35. I work hard to accomplish my goals.					
36. I often get angry at the way people treat me.					
37. I am a cheerful, high-spirited person.					
38. I believe we should look to our religious authorities for decisions on moral issues.					
39. Some people think of me as cold and calculating.					
40. When I make a commitment, I can always be counted on to follow through.					
41. Too often, when things go wrong, I get discouraged and feel like giving up.					
42. I am not a cheerful optimist.					
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.					

(SD) ***Strongly Disagree*** or the statement is definitely false
(D) ***Disagree*** if the statement is mostly false
(N) ***Neutral*** if you cannot decide, or the statement is equally true and false
(A) ***Agree*** or the statement is mostly true
(SA) ***Strongly Agree*** or the statement is definitely true

Question	SD	D	N	A	SA
44. I'm hard-headed and tough-minded in my attitudes.					
45. Sometimes I'm not as dependable or reliable as I should be.					
46. I am seldom sad or depressed.					
47. My life is fast-paced.					
48. I have little interest in speculating on the nature of the universe or the human condition.					
49. I generally try to be thoughtful and considerate.					
50. I am a productive person who always gets the job done.					
51. I often feel helpless and want someone else to solve my problems.					
52. I am a very active person.					
53. I have a lot of intellectual curiosity.					
54. If I don't like people, I let them know it.					
55. I never seem to be able to get organized.					
56. At times I have been so ashamed I just want to hide.					
57. I would rather go my own way then be a leader of others.					
58. I often enjoy playing with theories or abstract ideas.					
59. If necessary, I am willing to manipulate people to get what I want.					
60. I strive for excellence in everything I do.					

UNREP EVALUATION SURVEY

Introduction

This portion of the survey deals with how you would evaluate a junior ship handler. For the purpose of this survey, imagine that you have just supervised a young, less experienced junior officer who has completed the approach on an AE. Following completion of the evolution, you are tasked with evaluating the JOs performance and providing the JO with feedback about the execution of the approach. This portion of the survey is intended to determine the specific criteria you use to evaluate a conning officer's UNREP approach performance.

This inventory consist of 3 parts. While the entire inventory requires only about 15 minutes, there is no time limit. Please answer each of the following questions considering your requirements for a successful approach.

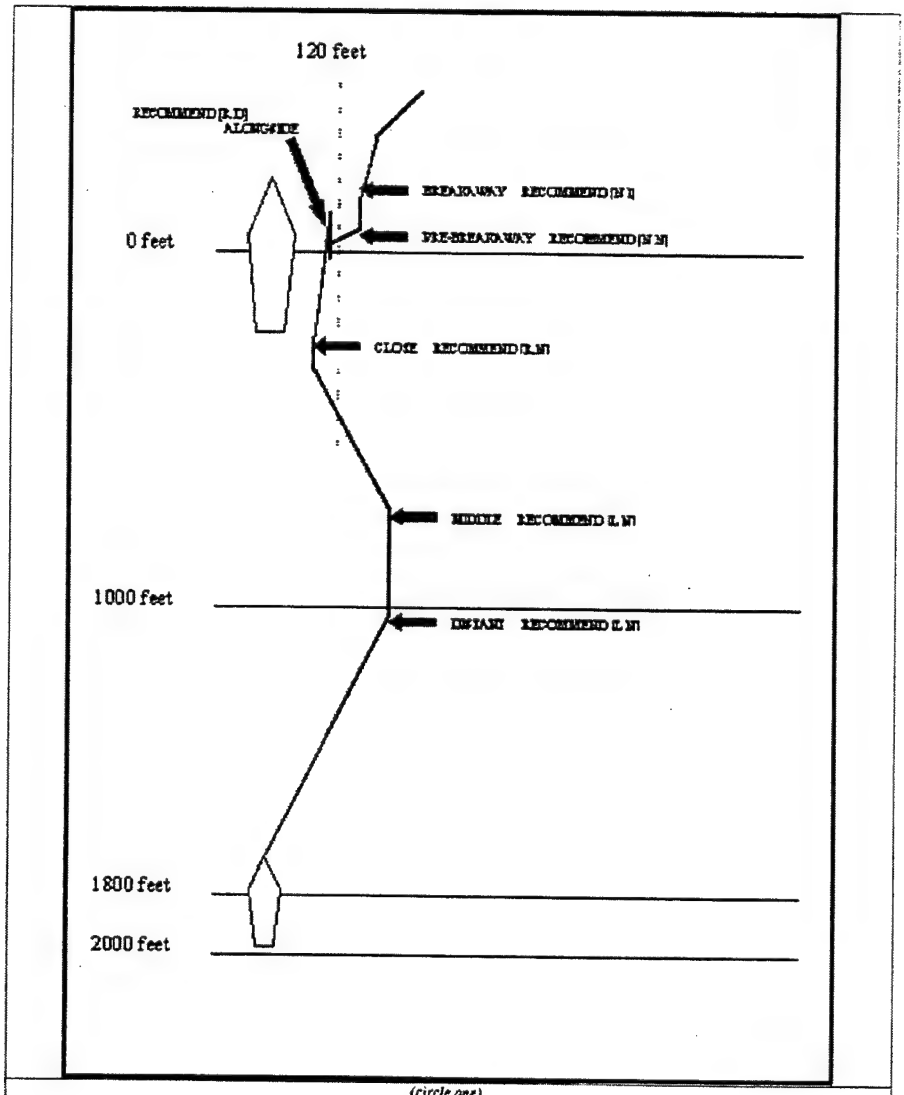
Part I

Part I requires you to evaluate each of the following 3 UNREP approach templates. Evaluation criteria for each of the three UNREP styles are:

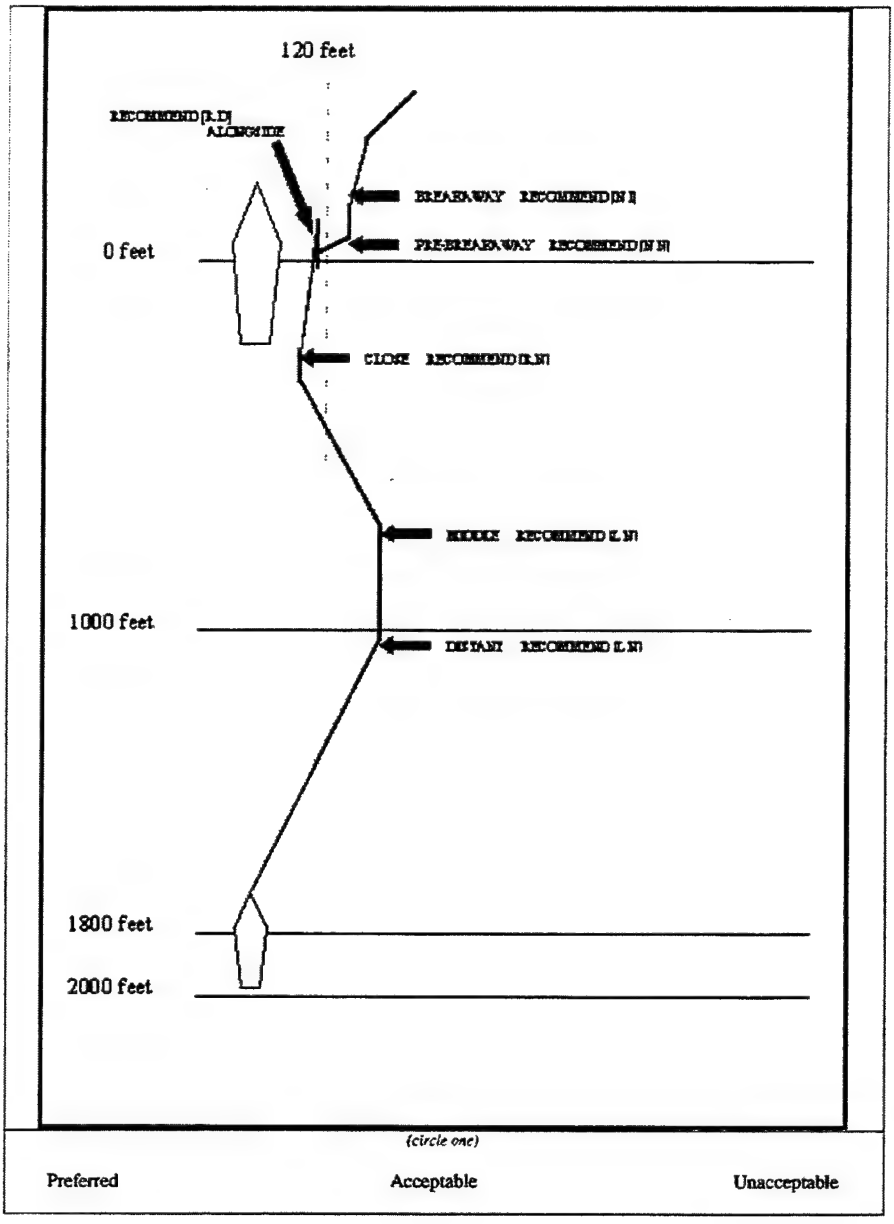
Preferred - This method most closely matches how you expect your Conning Officer to make the UNREP approach.
Acceptable - This method may not be exactly how you expect the approach to occur, but you have no objections to this type of execution
Unacceptable - You will not allow a Conning Officer to execute the UNREP in this fashion.

Legend For Diagrams
RECOMMEND [COURSE SPEED]

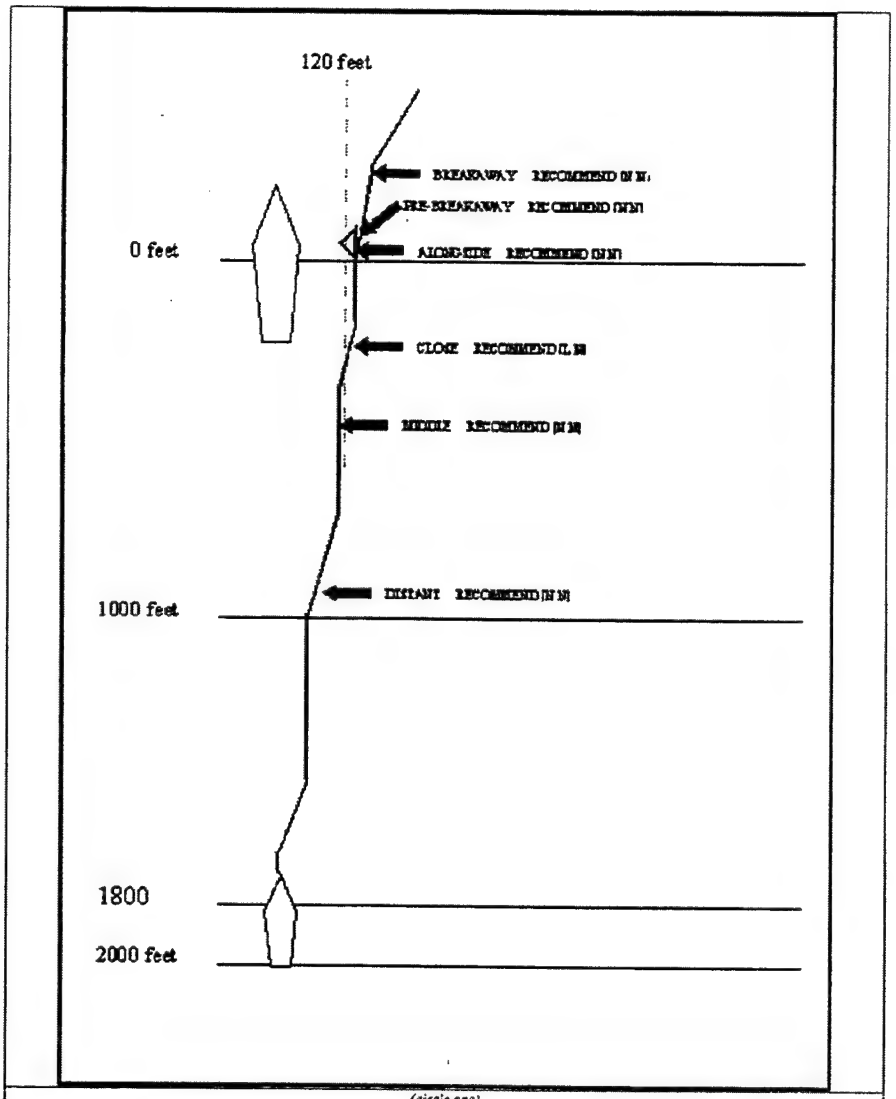
Course	Speed
L- Left	I- Increase
R - Right	D - Decrease
N - No Change	N - No Change


120 feet
0 feet
1000 feet
1800 feet
2000 feet
CLOSE RECOMMEND [L,M]
(circle one)
Preferred
Acceptable
Unacceptable

7


120 feet
0 feet
1000 feet
1800 feet
2000 feet
(circle one)
Preferred
Acceptable
Unacceptable

8



(circle one)

Preferred Acceptable Unacceptable

9

Part II

Part II covers specific criteria that may be used to evaluate a Conning Officer. Possible answers for each of the following questions in **Part II** are:

Not Applicable **(N/A)** -There is no need to perform this action.
Applicable **(A)** - This is a relatively minor action with large room for variation of execution.
Somewhat Important **(SI)** - An action that must be performed to have a successful UNREP approach, but with some room for variation of execution.
Important **(I)** – This action must be performed well to have a successful approach with little variation of execution.
Critical **(C)** - It is impossible to successfully complete an UNREP approach without performing this action flawlessly.

Please answer each of the following questions by providing one of the above ratings. If your ship does not have a required piece of equipment to perform an action, answer as if the required gear was installed on your ship.

Conning Officer Preparations/Qualifications *While you do not necessarily expect the Conning Officer to perform these actions, they are knowledge requirements for a good Conning Officer*	**N/A**	**A**	**SI**	**I**	**C**
1. Possesses an in-depth knowledge of own ship's numeric rates of acceleration/deceleration and other handling characteristics.					
2. Possesses an in-depth knowledge of handling characteristics of auxiliary ship *(e.g. acceleration and turn rates)*.					
3. Possesses an understanding how Own Ship's vibrations correspond to speed and rudder commands.					
4. Possesses an ability to sense environmental factors.					
5. Possesses an understanding of wind force effects on ship's freeboard.					
6. Possesses understanding of depth of ocean effects.					
7. Possesses understanding of topography of ocean floor effects.					
8. Possesses understanding of sea state effects.					
9. Possesses understanding of direction of seas effects.					
10. Possesses understanding of Bernoulli forces.					
11. Possesses understanding of JA/Integrated ship's circuit.					
12. Possesses understanding of radio headset/walkie-talkie for internal communications.					
13. Possesses understanding of Bridge to Bridge handset.					

10

***Not Applicable* (N/A)** -There is no need to perform this action.
***Applicable* (A)** - This is a relatively minor action with large room for variation of execution.
***Somewhat Important* (SI)** - An action that must be performed to have a successful UNREP approach, but with some room for variation of execution.
***Important* (I)** – This action must be performed well to have a successful approach with little variation of execution.
***Critical* (C)** - It is impossible to successfully complete an UNREP approach without performing this action flawlessly.

Conning Officer Preparations/Qualifications *While you do not necessarily expect the Conning Officer to perform these actions, they are knowledge requirements for a good Conning Officer*	**N/A**	**A**	**SI**	**I**	**C**
14. Possesses understanding of UHF.					
15. Possesses understanding of cellular communication.					
16. Possesses understanding of lights *(for communication)*.					
17. Possesses understanding of semaphores.					
18. Possesses understanding of formal decision aids *(information boards, checklists, flow charts etc..)*.					
19. Possesses understanding of NWP procedure.					
20. Possesses understanding of SOPs.					
21. Displayed proper use of MOBOARD.					

***Not Applicable* (N/A)** -There is no need to perform this action.
***Applicable* (A)** - This is a relatively minor action with large room for variation of execution.
***Somewhat important* (SI)** - An action that must be performed to have a successful UNREP approach, but with some room for variation of execution.
***Important* (I)** – This action must be performed well to have a successful approach with little variation of execution.
***Critical* (C)** - It is impossible to successfully complete an UNREP approach without performing this action flawlessly.

Execution *These are actions you expect a good Conning Officer to perform well during the UNREP approach*	**N/A**	**A**	**SI**	**I**	**C**
1. Maintained close verbal communication between Conn and CO/XO during approach.					
2. Maintained regular communications between own ship and Auxiliary during approach.					
3. Displayed proper use of face to face communications.					
4. Displayed proper use of JA/Integrated ship's circuit.					
5. Displayed proper use of radio headset/walkie-talkie for internal communications.					
6. Displayed proper use of Bridge to Bridge handset.					
7. Displayed proper use of UHF.					
8. Displayed proper use of cellular communication.					
9. Displayed proper use of lights *(for communication)*.					
10. Displayed proper use of semaphores.					
11. Displayed proper use of formal decision aids *(information boards, checklists, flow charts etc..)*.					
12. Displayed proper formal use of NWP procedure.					
13. Displayed proper use of SOPs.					
14. Displayed proper use of rules of thumb *(non-numeric, non-calculation based)*.					
15. Displayed proper use of radian rule *(and any other calculation based rule of thumb)*.					
16. Displayed proper use of an internal checklist or other systematic routine for completion of milestones.					
17. Displayed proper use of a scan routine for input.					
18. Displayed proper visual observation of wake to judge relative motion.					
19. Displayed proper visual observation of relative perspective to judge relative motion.					
20. Displayed proper visual observation of rate of closure to judge relative motion.					
21. Displayed proper and timely use of GPS position/speed.					
22. Displayed proper use of MOBOARD.					
23. Displayed proper and timely use of Stadimeter information.					
24. Displayed proper and timely use of Radar range information.					
25. Displayed proper visual estimations of range.					
26. Displayed proper and timely use of laser rangefinder information.					

Part III

Part III consists of some general questions about UNREP approaches. Answers for **Part III** consist of multiple choice and fill in the blank that best correspond with your expert style of ship driving.

What is your minimum allowable lateral separation? *(in feet)*	
What is your maximum allowable lateral separation? *(in feet)*	
What is your ideal approach speed differential? *(in knots)*	
What is your ideal distance behind the Auxiliary prior to commencement of approach? *(in yards)*	
What is an adequate amount of time to perform an approach for a new Junior Officer? *(circle one)*	Under 5 minutes Between 5 and 10 minutes Between 10 and 15 minutes Between 15 and 20 minutes Greater Than 20 minutes Time is a function of speed and distance There is no "adequate" amount of time
What is an adequate amount of time to perform an approach for an experienced Senior Officer? *(circle one)*	Under 5 minutes Between 5 and 10 minutes Between 10 and 15 minutes Between 15 and 20 minutes Greater Than 20 minutes Time is a function of speed and distance There is no "adequate" amount of time
How would you characterize your management of Conning Officers during an UNREP? *(circle one)*	I allow large variations in execution from my preferences I allow some variations in execution from my preferences I allow no variations in execution from my preferences

13

Which statement best describes the NWP? *(circle one)*	NWP is a detailed recipe for UNREP NWP is only a loose framework for UNREP
Which are you most comfortable with: *(circle one)*	A conning officer who primarily uses rules of thumb, ship's instruments and other guidelines to make decisions? *(someone who knows numbers and facts)* or A conning officer who primarily uses his instincts and sensory estimations? *(someone who drives a ship like a car on the highway)*

CONCLUSION

Thank you for taking your valuable time to complete this survey. The goal of this research is to determine how to tailor feedback provided to a Junior Officer (JO) during training in a Virtual Environment (VE) ship handling training simulator such as NAWCTSD's Conning Officer Virtual Environment (COVE). Tailored feedback allows a simulator to train a JO in a way that is compatible with the JO's Commanding Officer's ship handling style. If a JO can receive feedback that is similar to the feedback he receives from his shipboard mentor, the JO will have more effective simulator training time and be more productive while at sea.

If you would like to leave suggestions or comments, feel free to enter them on the back of this survey:

LT. Chris Buziak, USN[2]
Code 32, Naval Postgraduate School
833 Dyer Road, Rm 404
Monterey, CA 93943-5000
(831) 656-4679 DSN 878-4679

Please encourage your expert peers to participate in this survey. Greater expert participation will improve the results and create a better product released to the fleet.

For additional questions or comments about this research, please contact:

[2] Email any questions to LT. Chris Buziak at buziak@cs.nps.navy.mil

Enter Your Comments Here

15

APPENDIX E. UNREP CHARACTERISTICS BASED UPON APPROACH SHIP CLASS

	SMALLEST OBSERVED MINIMUM ALLOWABLE LATERAL SEPARATION (FEET)	AVERAGE MINIMUM ALLOWABLE LATERAL SEPARATION (FEET)	LARGEST OBSERVED MINIMUM ALLOWABLE LATERAL SEPARATION (FEET)
CG	80	117	140
CV/CVN	120	136	140
DD/DDG	80	122	150
FFG	60	109	160
Transport Ship	80	135	180

Table 7. Minimum Allowable Lateral Separation Between Approach Ship and Replenishment Ship Based Upon Approach Ship Class

	SMALLEST OBSERVED MAXIMUM ALLOWABLE LATERAL SEPARATION (FEET)	AVERAGE MAXIMUM ALLOWABLE LATERAL SEPARATION (FEET)	LARGEST OBSERVED MAXIMUM ALLOWABLE LATERAL SEPARATION (FEET)
CG	160	185	200
CV/CVN	180	200	220
DD/DDG	140	189	250
FFG	110	182	240
Transport Ship	140	203	300

Table 8. Maximum Allowable Lateral Separation Between Approach Ship and Replenishment Ship Based Upon Approach Ship Class

	SMALLEST OBSERVED SPEED DIFFERENTIAL (KNOTS)	AVERAGE OBSERVED SPEED DIFFERENTIAL (KNOTS)	LARGEST OBSERVED SPEED DIFFERENTIAL (KNOTS)
CG	5	9	18
CV/CVN	3	5	6
DD/DDG	5	7	20
FFG	5	11	25
Transport Ship	3	6	18

Table 9. Allowable Approach Speed Differential
Between Approach Ship and Replenishment Ship
Based Upon Approach Ship Class

	SMALLEST OBSERVED STARTING DISTANCE (YARDS)	AVERAGE OBSERVED STARTING DISTANCE (YARDS)	LARGEST OBSERVED STARTING DISTANCE (YARDS)
CG	400	671	1000
CV/CVN	1000	1800	2000
DD/DDG	160	623	3000
FFG	300	652	1500
Transport Ship	300	748	1800

Table 10. Allowable Starting Distance For Approach
Between Approach Ship and Replenishment Ship
Based Upon Approach Ship Class

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